LIBRARY


# JOURNAL OF OIL & FAT INDUSTRIES

*The Official Organ of The American Oil Chemists' Society*

Vol. III JANUARY, 1926 No. 1


## CONTENTS


Editorials ..... 1

Original Contributions:

China Wood Oil—*Maximilian Toch* ..... 3

Digestibility of Fats Taken from the Animal Body —*Arthur D. Holmes* ..... 11

Soap as a Disinfectant and Antiseptic—*L. W. Bosart* ..... 18

Theory of Emulsions and Emulsification— *P. M. Travis* ..... 21

November Imports of Olive, Peanut and Cocoanut Oils 26

Proceedings of the Sixteenth Annual Convention:

The Report of the Moisture Committee—*P. S. Tilson* ..... 27

A Preliminary Report of the Planning Committee —*David Wesson* ..... 29

Report of the Seed Committee ..... 30

Statistics of Fats and Oils ..... 37

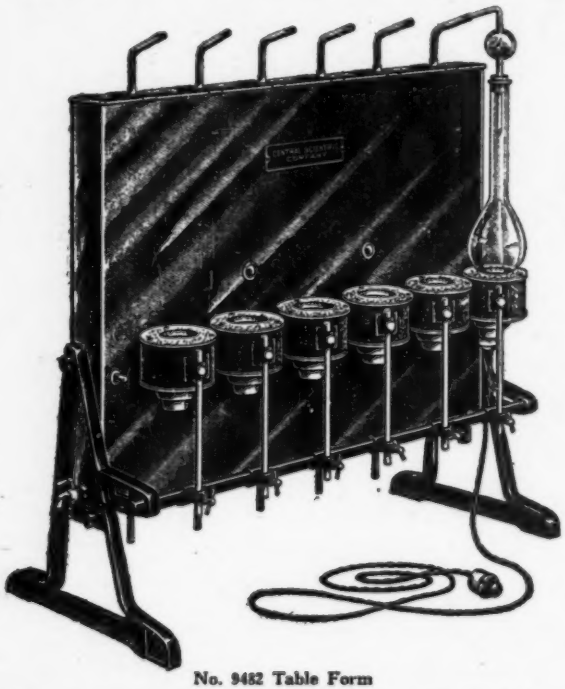
Abstracts ..... 40

# ARE YOU USING ELECTRICALLY HEATED APPARATUS?

**Ask for Information About The**

**CENCO ELECTRIC**

## Nitrogen Distilling Apparatus



No. 9482 Table Form

### Prices Now Compare Favorably With Gas Heated Apparatus

**9482. KJELDAHL DISTILLING APPARATUS**

**TABLE FORM** without glassware.

| No. | A | B |
|---|---|---|
| For volts | 110 | 220 |
| Each | $105.00 | $110.00 |

**9481. KJELDAHL DISTILLING APPARATUS**

**WALL FORM** without supports but with hooks for hanging on the wall.

| No. | A | B |
|---|---|---|
| For volts | 110 | 220 |
| Each | $103.00 | $108.00 |

**9466. KJELDAHL DIGESTION APPARATUS**

| No. | A | B | C | D |
|---|---|---|---|---|
| Number of heaters | 6 | 6 | 10 | 10 |
| For volts | 110 | 220 | 110 | 220 |
| Each | $50.00 | $53.00 | $80.00 | $85.00 |

**For Complete Description Send for Bulletin 93CC.**

**CENTRAL SCIENTIFIC COMPANY**

LABORATORY Apparatus CENCO Chemicals SUPPLIES

460 E. Ohio St., Chicago, U.S.A.

# Journal of Oil and Fat Industries

**Devoted to Oils, Fats and Allied Industries**

**VOL. III** **JANUARY, 1926** **No. 1**

## EDITORIAL

### OUR HAMMER

The Hammer in the oil technologist's tool kit is a publication devoted to his profession. The American Oil Chemists' Society believes there is a place for such a periodical in the rather numerous family of Technical Magazines and has maintained for nearly two years THE JOURNAL OF OIL AND FAT INDUSTRIES. The reception accorded this quarterly, not only in America but in many foreign countries has seemed to bear out this supposition.

In spite of the difficulties incident to the birth of any scientific publication it has from the start been kindly received and supported. Its pages at times may have been a bit padded but by far the most of the articles it contained were worthy of a permanent place among the records of the industries' achievements.

Beginning this year, 1926, the Journal comes out in new form and under a little different management. It will, in the future, be a monthly and the scope of its articles somewhat broadened. The A. O. C. S., however, is still squarely behind it and all papers of a strictly scientific and technical nature are passed upon by the Society's Editorial Board before being printed.

To the artisan, irrespective of his particular trade, a hammer is an absolute necessity. The carpenter certainly cannot build the simplest box without one. The structural steel man and the boiler-maker may have their pneumatic riveters; but these are only super-hammers and at that do not entirely replace the old ball-pein. The fellows in the mines and quarries still swing away with their sledges in spite of electric drills, and how would the village smithy make music without the clang-clang on his anvil? Even the doctors and the musicians need hammers.

A prerequisite to success in any profession is a knowledge of the work of one's fellow laborers. The information in text-books is useful,

but to the chemical technologist in much the same category as the history of Napoleon's wars to General Pershing. It is their acquaintance with the new discoveries and inventions, new methods of analysis, new materials for construction, and new statistics of production that mark the leaders in our profession.

A monthly is better than a quarterly because it not only gives one the work of his confrere more promptly and more often, but tends to hold together more closely all those who are laboring on the same structure. We work with more enthusiasm and to better purpose when we can hear the ring of the other fellow's hammer: No! not knocking.—H. S. B.

## SYMPOSIUM ON COTTON SEED AND OTHER VEGETABLE OILS AND COTTON SEED PRODUCTS

This Symposium will be held at the Tulsa meeting of the American Chemical Society in April. Papers connected with refining processes and chemistry of Cotton Seed and other vegetable oils, also papers relating to the feeding value and toxicity of by-products and feeding stuffs will be particularly welcome.

The Symposium will be held under the auspices of the Agricultural and Food Division, with cooperation of the Biological Division.

David Wesson, 120 Broadway, New York, will act as Chairman and will be glad to hear from those having papers to offer. Under the rules of the American Chemical Society, papers are expected only from members, unless the authors happen to be men of special note and have papers to present of very unusual interest.

# CHINA WOOD OIL

## By MAXIMILIAN TOCH

The article that follows appears as a chapter in the third and most recent edition of a book by the author, entitled Chemistry and Technology of Paints. The paper deserves to rank as the most complete, up-to-date and authoritative discussion of China Wood Oil that has been published. To quote Dr. Toch: "Our viewpoint on China Wood Oil has been largely changed, due primarily to investigations of the growth of the tung oil tree and the collection and expression of the seeds, and for the further reason that the transplantation of the tung oil tree on a large scale in the United States has given us an oil which differs materially from that which we have considered standard China Wood Oil." The importance of the work, specially as it affects the paint industry, is such that we have secured permission to reprint part of the chapter from the author aad from the publishers, D. Nostrand & Company, New York.—*THE EDITOR.*

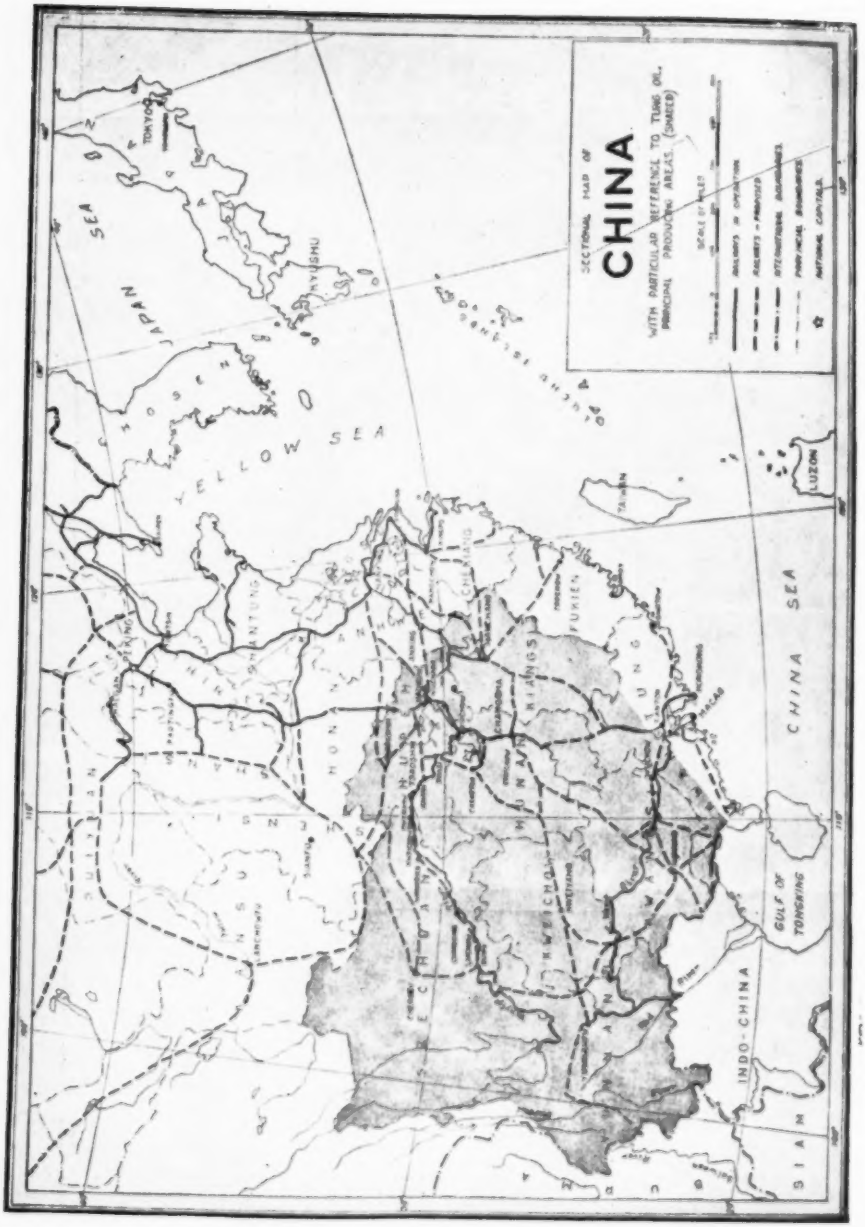
China wood oil is also known as tung oil. It is obtained from the seeds of a tree which grows principally in China. Very little attention is paid to its cultivation, and it is estimated that not five per cent of the trees in China are taken care of, although any statistical record with reference to China is not to be relied upon. The trees, without any fertilization, grow to a height of 30 to 40 feet. They also seem to thrive on waste land and rocky soil where there is sufficient rain.

The area in which the tung oil tree flourishes is an area between 23 degrees and 33 degrees north latitude, approximately 600 miles; and from 95 degrees to 115 degrees west longitude, approximately 1,200 miles. The same indigenous difference takes place in the seeds grown in these latitudes and longitudes that there is in tobacco grown in the United States in the same relative area. The trees in the South mature quicker, but the trees in the North are hardier, so that the Hupeh and Szechwan provinces really produce the finest grade of oil. The tung oil tree grows in fact as far north as Shanghai where there is snow and ice, so that there is no reason why the tree cannot be planted where they have cold winters.

The nuts, produced by the tree, contain three, four, or five seeds enclosed in a very dense shell. I have seen nuts that have been worm-eaten, decomposed, and in an otherwise unsuitable condition for pressing. Very little care is exercised in their selection. The seeds are generally roasted over fires to split the outer shell, and whether they are over-heated or under-heated makes very little difference to the native producers.

After roasting, the seeds are ground and are then ready to be pressed. The presses, which are similar to the antediluvian type of Biblical times, are hollowed out of the trunks of hard wood trees. The ground cake is placed inside and the oil is pressed out by driving in wedges. The oil is collected in wicker baskets that are paper-lined, and dead animals, insects, and other offal frequently find their way into these baskets, although more care is exercised at present. This is one of the reasons why there has been so much difference in the constants of China wood oil. The adulteration with other oil also made a great difference in the material that has been shipped to foreign countries.

The actual chemical composition of China wood oil will probably be




**Black Area Shows Tung Oil Region**

established with more certainty than it is at present, when a standard shall have been made of oil, which is expressed with modern machinery or extracted with solvents, from selected nuts grown on fertilized soil. But suffice it to say that China wood oil consists principally of elaeomargarine, also known as elaeostearine.

Much of the literature of China wood oil is hearsay, as, for instance, the statement that the Chinese have used it for thousands of years on junks and other woodwork in its raw state. It is probably true that for many centuries this has been the principal oil for varnishing or waterproofing paper, such as umbrellas, the backs and sides and masts of the junks, and wooden floors of compounds. On the finer class of river craft, and on table tops and inlaid furniture I found that Ningpo lacquer, and a mixture of lacquer and China wood oil, was used.

Another myth that has appeared from time to time, is that Hankow oil is the only good oil produced in China, and Canton oil is no good. As a matter of fact, there is no such thing as Canton, Hankow or Hongkong oil. These cities are simply collecting points, and one might just as well speak of Liverpool, Buffalo or Duluth linseed oil.

The importance of China wood oil in the paint and varnish industry may be simply expressed by the fact that in 1896 a few barrels were exported, whereas in 1924 fifteen million dollars' worth was exported.

The Chinese merchant is no different from the merchant of any other country in so far as he will adulterate any product with a cheaper material in order to make additional profit. This has led the Chinese to use any oil which is cheaper than China wood oil, and at this writing mineral oil or paraffine oil is used. This adulterant is about one-third the price of China wood oil, and somewhere between the pressing of the nuts up the Yang-tse River and the delivery of the oil to Hankow or Canton other oils have been added in the nature of adulterants and this has done the industry and the manufacturers a great deal of harm.

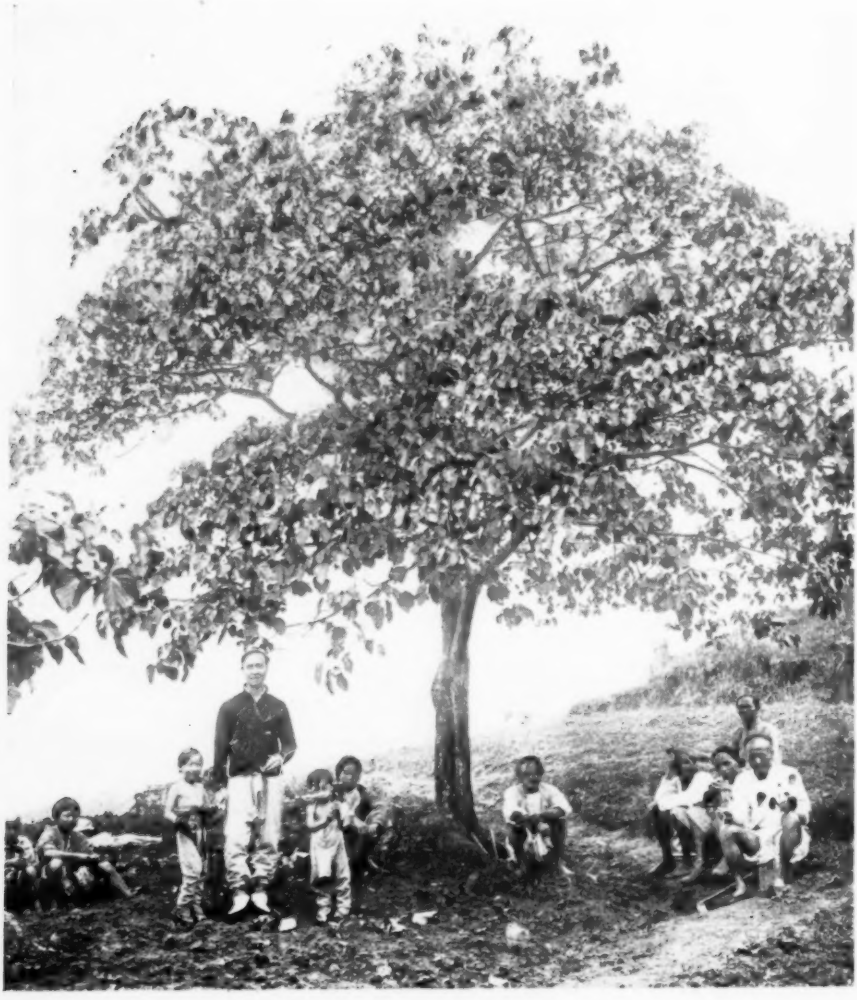
For years many chemists have been at work standardizing China wood oil, and given ample time, it is quite possible to determine the purity of any shipment of China wood oil within reasonable limits.

The average constants of China wood oil known to be pure all indicate that the oil must have a gravity of at least .940 at 15.5 degrees C., but China wood oil can be pure and have a specific gravity of .938. The iodine value will range between 159 and 167, the saponification 190, and the acid value from one to seven.

A great many determinations of the constants of China wood oil of known origin and direct importation were made, as will be seen in the following pages. An investigation on the examination of the same types of oil mixed with 5, 10 and 15 per cent of other oils has also been tried.

It is worthy of note that the heat test alone as indicated in some of these samples is not significant, and varnishes made with China wood oil adulterated with 5 per cent of many oils do not give any immediate indication of admixtures. The variation in acid number is a factor in polymerization. The higher the acid number, the longer the oil takes to polymerize.

However, from the business standpoint no manufacturer wants to buy an oil which is impure, and the tests up to the present writing permit the acceptance of oils that are not pure. The object, however, of this lengthy and careful investigation is to establish a method which shall be quick and



**The Tung Oil Tree in China**

accurate, and which will indicate beyond peradventure that the China wood oil examined is pure or impure. As every one in factory practice knows, when a shipment of material is delivered, the cost of taking it into the warehouse and putting it in tanks while it is being analyzed involves labor and expense which is part of the business organization if the material is accepted, but if the material is impure and has to be pumped out of tanks and re-filled into barrels or other containers and shipped back again to the consignee, it adds undue expenses which may or may not be refunded.

It is for that purpose that I am establishing the following methods for the testing of China wood oil which are quick and absolutely correct. After these tests have been made, should further tests be desired, such as saponification, acid number, iodine number, polymerization, etc., they can be done at leisure, but these tests take a long time, and can only be used to establish, ratify and corroborate any previous decision.

It is perfectly possible to adulterate China wood oil with 5 per cent paraffin oil so that it will pass the polymerization test, and have the accepted specific gravity, but it is very simple to detect the admixture of an oil of this kind even though the gravity and polymerization are correct if the refractive index and color dispersion are made.

**American Tung Oil Tree, Two Years Old**

Specific gravity, color dispersion, and refractive index occupy only a few minutes, and when these three constants agree with the established standard for pure oil, it is absolutely positive that all the other constants will be in harmony.

Referring again to the case of the adulteration of China wood oil with paraffin oil,[1] and where the saponification test is made, it is easy enough to extract paraffin oil, because it will not saponify. When 5 per cent of any oil is added to China wood oil, one of the two indicators, that is, either refractive index, or color dispersion, will be thrown out of standard, and up to now no sample of adulterated oil which we have examined gives discordant figures for all three of the indicators which I propose.

The best instrument of the kind is the Abbé type of refractometer.

There is only one wood oil refinery in China. This is owned by a Chinese corporation at whose head there is an English chemist. All the others are warehouses and oil storage plants where the oil is received in baskets, strained and placed in tanks where it is heated up to about 105° C. and allowed to set anywhere from one week to a month or more, depending entirely upon commercial conditions.

The foots or sediment are returned to the original Chinese shippers and not paid for, and this oil finds a ready market among the Chinese for waterproofing various fabrics and for the varnishing of junks.

The Chinese are exceedingly apt in heating tung oil in little earthenware dishes at low temperatures, principally not over 125° C., and it is kept at this temperature until the oil thickens slightly. It is then applied by means of either a stiff brush or rubbed on the wooden surface of the junk and scraped off. In this manner many coats are applied.

For the varnishing of floors, in China in some of the private houses, called compounds, the floors are most beautifully polished. A small amount of Ningpo Varnish is added to the wood oil.

## The Refining of Crude China Wood Oil

Crude China wood oil is turbid and has a yellow color and a characteristic odor. The two samples of crude oil taken for this investigation were received direct from Hankow. They show the following constants:

| | | |
|---|---|---|
| 1. | Specific Gravity (60° F.) | 0.9399 |
| | Refractive Index (21.5° C.) | 1.5176 |
| | Dispersion Value (21.5° C.) | 0.02025 |
| | Heat Test (Browne's) | 11¼ min. |

[1]This was first worked out under the name of the Potsdamer method, in the laboratory of Toch Brothers, Inc., Long Island City, more than thirteen years ago. See "A Method for the Detection of Adulteration of China Wood Oils," L. S. Potsdamer, Eighth International Congress of Applied Chemistry, Sec. Ve, 1912

2. Specific Gravity (60° F.) ..... 0.9408
Refractive Index (21.5° C.) ..... 1.5176
Dispersion Value (21.5° C.)) ..... 0.02032
Heat Test (Browne's) ..... 11 min.

Three general processes of refining the crude oil were tried in the laboratory: (1) Heating. (2) Oxidation. (3) Absorption.

The procedure for each experiment was varied in order to find out under what conditions the best result could be obtained. However, in each case two hundred grams of oil were treated in a beaker having a capacity of 400 c.c. The exact manipulation and the effect of such treatment upon the constants of the original oil will now be described carefully: [from (a) to (d) refer to crude oil No. 1; and (e) and (f) refer to crude oil No. 2].

(a) 1 per cent of barium peroxide, mixed with 50 c.c. of water, was added to the crude oil. The mixture was then heated up to 90° C., when dilute sulphuric acid was added drop by drop to evolve the oxygen from the barium peroxide. The oil, after such treatment, was poured into another beaker. One per cent of powdered pumice and 1 per cent of Fuller's earth were then added. The mixture was again heated to 105° C. and agitated for 30 minutes. The oil was not clear after filtration and on further standing the white precipitate increased. Upon examination, it had the following constants:

Specific Gravity (60° F.) ..... 0.9399
Refractive Index (21.5° C.) ..... 1.5177
Dispersion Value (21.5° C.) ..... 0.02039
Heat Test (Browne's) ..... 10½ min.

Whenever crude China wood oil is treated with barium peroxide, the oil is bleached; but it does not remain clear on standing. This is probably due to formation of an insoluble barium compound, resulting from the chemical reaction between barium peroxide and the oil.

Flashing is liable to take place when barium peroxide, without the addition of water, is heated up with the oil. This can be avoided by first bringing the oil up to a high temperature, and then dropping in the barium peroxide.

(b) The oil was treated with 2.5 per cent of an activated carbon. The mixture was heated up to 105° C. and stirred for half an hour. After filtration, the oil was clear and bleached to a certain extent. The constants of this oil were:

Specific Gravity (60° F.) ..... 0.9405
Refractive Index (21.5° C.) ..... 1.5178
Dispersion Value (21.5° C.) ..... 0.02048
Heat Test (Browne's) ..... 10½ min.

A peculiar chemical action was observed—that the oil which was treated with an activated carbon began to crystallize in four or five days and finally turned entirely into a solid white mass. The acid numbers of this oil and of the original oil are practically the same, being 8.6 and 8.75 respectively. The melting point of the solidified tung oil is between 51° and 53° C. This solid form is probably the glyceride of B-Elaeostearic acid, formed by a molecular rearrangement of the liquid form and which is catalized by activated carbon. It was first noticed by Cloez that light has the same effect of changing liquid tung oil into the solid form.

(c) The crude oil was simply heated up to 200° C. and the temperature maintained for ten minutes and finally filtered. The oil obtained has the following constants:

| | |
|---|---|
| Specific Gravity (60° F.) | 0.9420 |
| Refractive Index (21.5° C.) | 1.5170 |
| Dispersion Value (21.5° C. | 0.02000 |
| Heat Test (Browne's) | 10½ min. |

(d) The crude oil was mixed with 5 per cent of Fuller's earth and heated to 150° C. for fifteen minutes with constant stirring. After filtration, a very light colored clear oil was obtained. The oil also remains in good condition on standing. Its constants may be shown in the following table:

| | |
|---|---|
| Specific Gravity (60° F.) | 0.9401 |
| Refractive Index (21.5° C.) | 1.5179 |
| Dispersion Value (21.5° C.) | 0.02053 |
| Heat Test (Browne's) | 10½ min. |

(e) For thirty minutes the crude oil was heated up to 120° C. with 1 per cent bone black. Then it was filtered. The oil was clear and bleached to some extent. It had the following constants:

| | |
|---|---|
| Specific Gravity (60° F.) | 0.9397 |
| Refractive Index (21.5° C.) | 1.5176 |
| Dispersion Value (21.5° C.) | 0.02043 |
| Heat Test (Browne's) | 10½ min. |

(f) The crude oil was treated with 2 per cent of Fuller's earth and 2 per cent of bone black. The mixture was heated up to 120° C. for thirty minutes and then filtered. The oil obtained was very pale in color and clear. It had the following constants:

| | |
|---|---|
| Specific Gravity (60° F.) | 0.9395 |
| Refractive Index (21.5° C.) | 1.5175 |
| Dispersion Value (21.5° C.) | 0.02042 |
| Heat Test (Browne's) | 10½ min. |

Many other methods have also been tried in the laboratory such as the use of the oxygen liberated from manganese dioxide, potassium bichromate, and sodium peroxide. Bleaching with sulphur dioxide and chlorine gas did not give any striking effect. Among all the methods tried bleaching with 5 per cent Fuller's earth, or with a combination of Fuller's earth and bone black, gave the best result.

*(To be concluded in February)*

# DIGESTIBILITY OF FATS TAKEN FROM THE ANIMAL BODY

By ARTHUR D. HOLMES

Note: Since fats from cattle are included in nearly all diets, the following resume of digestion experiments, conducted by the author while employed as physiological chemist at the U. S. Dept. of Agriculture, is given to supply information concerning the digestibility of such fats when included in a simple mixed diet.

For a long time it has been recognized that fats from different parts of the animal body exhibit a lack of uniformity as regards chemical and physical characteristics. Henriques and Hansen[1] reported that fats from the interior and exterior of the same animal were characterized by a difference in melting points and iodin numbers. Richardson[2] found that the melting point of leaf lard was several degrees higher than that of the back fat of the same animal. Some years later Richardson and Farey[3] reported a variation of 12° to 22° C. in melting points of leaf lard, ham fat, and back fat.

A number of investigators have studied the extent to which the composition of the diet influences the characteristics of the fats found in the fat depots of the body. Shutt[4] conduced a series of feeding experiments to determine the effect of the nature of the diet of pigs upon the quality of pork obtained from them and found a marked variation in appearance and characteristics of pork produced from different rations. The melting point of "soft pork" was often 10° C. lower than that of firm bacon. These results were substantiated by Richardson[2], who determined the characteristics of lard from oily hogs. Rosenfield[5] says a horse fattened on oats will produce a liquid fat, but if fattened up on hay the body fat will be much firmer and that the similarity of the body fat of the ox, sheep, roe and hart is directly referable to their diet of grasses. Rohmann[6] reports that fats foreign to the diet of birds may, just as in milk, pass into the secretion of the coccygeal gland.

Furth[7] quite evidently believes that the characteristics of the fats found in the human body are to some extent influenced by the nature of the diet, for he states that the skin fat of children fed upon human milk is always richer in insaturated fatty acids than of the artificially fed infants.

As a result of these observations the question very naturally arose as to the relative digestibility of fats taken from different parts of the body. Flurin[8] studied the relative digestibility of beef tallow and butter

[1]Skand. Arch. Physiol., Vol. 11 (1901), No. 3-4, pp 151-165.
[2]Jour. Amer. Chem. Soc., Vol. 26 (1904), No. 4, pp 372-374.
[3]Idem., Vol. 30 (1908), No. 7, pp 1191-92.
[4]Canada Expt. Farms Repts. (1889), pp 151-155; Idem. Bull. 38 (1901).
[5]Ergebn. d. Physiol., Vol. 1 (1902), p 676.
[6]Hofmeister's Beitr., Vol. 5:10 (1904) (Breslau).

and found on the average butter was 96% digested and beef tallow 93% digested. Levites[2] found butter and beef fat were both 96% digested. Grindley,[4] in an extended study of the effect of different methods of cooking upon the thoroughness and ease of digestion of meat beef, reports as follows:

| Number of experiments | Cut and method of cooking | | Digestibility of fat |
|---|---|---|---|
| 5 | Lean round of beef cooked in water at 80°-85°C. | 1 hr. | 92.6% |
| 5 | " | 2 hrs. | 90.4% |
| 2 | " | 3 hrs. | 96.6% |
| 3 | Lean round pan broiled | | 98.2% |
| 3 | " " fried in hot lard | | 97.7% |
| 3 | " " roasted | | 99.7% |
| 3 | Fat shoulder cooked in water 80°-85°C. | 2 hrs. | 97.3% |
| 7 | Beef ribs roasted | | 99.4% |

## Experimental

In view of the extensive use in the average dietary of fats derived from cattle, it has seemed of interest to compare the digestibility of fats taken from different parts of the body of beef animals, especially when the determination of these coefficients has been obtained under uniform experimental conditions. Accordingly, the essential data for interpreting the results of series of experiments with brisket fat, butter, cream, hard palate fat, kidney fat, oleo oil, oleo stearin, ox-marrow fat, and ox-tail fat have been brought together in a table which appears on page 13.

The experimental procedure for these experiments has been outlined in detail in previous papers. Briefly stated the experimental diet consisted of wheat biscuits, fruit, sugar, tea or coffee and a cornstarch blancmange which served as a vehicle for the fat under consideration and which was so flavored as to mask its presence. This diet was eaten by normal human subjects for a nine meal, or three-day period, and the difference between the amount of fat ingested and that excreted was considered as the amount digested.

Of the fats discussed below butter and cream were purchased as such in the open market. Kidney fat, brisket fat and hard palate fat were rendered from beef tallow, beef briskets and hard palates under laboratory conditions. The remaining fats, oleo oil, oleo stearin, ox-marrow fat and ox-tail fat were secured from one of the large packing houses and all of the fats were believed to be typical of those purchased by the average consumer.

In order to make an accurate comparison of the digestibility of fats taken from different parts of the animal body the fats should be obtained

[1]Problems of Physiol. & Pathological Chem. of Metabolism (1916), p 383. Lippincott Co., Phila. and London.

[2]Diss. Army Med. Acad., St. Petersburg (1890), p 52.

[3]Ztschr. Physiol. Chem. 49 (1906), No. 2-3, pp. 273-285.

[4]U. S. Dept. Agri. Office Exprts. Sta. Bul. 193 (1907), p 41.

from the same animal. In this instance, however, such a procedure was impossible as the amount of brisket fat, hard palate fat, ox-marrow fat and ox-tail fat required for a series of experiments could not be obtained from a single animal. It is felt, however, that the results reported below are truly representative of the fats under consideration and that these results are applicable to these fats as obtained from commercial sources.

The data essential for comparison of the digestibility of the different fats under consideration are given in the table below. The discussion which follows contains additional information concerning the individual fats.

SUMMARY OF DIGESTION EXPERIMENTS WITH FATS TAKEN FROM DIFFERENT PARTS OF THE ANIMAL BODY

| Number of experiments | Kind of fat studied | Amount of fat eaten daily | Digestibility of the entire ration | | | Digestibility of fat studied |
|---|---|---|---|---|---|---|
| | | | Protein | Fat | Carbohydrate | |
| | | grams | % | % | % | % |
| 7 | Brisket Fat | 82 | 58.4 | 92.8 | 96.4 | 97 |
| 8 | Butter | 100 | 70.5 | 93.9 | 96.4 | 97 |
| 7 | Cream | 78 | 65.2 | 92.7 | 96.1 | 97 |
| 3 | Hard Palate Fat | 90 | 50.9 | 90.5 | 97.6 | 94 |
| 10 | Kidney Fat | 100 | 75.6 | 88.9 | 96.7 | 94 |
| 8 | Oleo Oil | 59 | 52.8 | 90.4 | 96.0 | 97 |
| 3 | Oleo Stearin | 68 | 40.5 | 71.8 | 94.7 | 80 |
| 4 | Ox-Marrow Fat | 89 | 59.2 | 91.2 | 97.4 | 94 |
| 3 | Ox-tail Fat | 77 | 74.6 | 93.0 | 96.3 | 97 |

## Brisket Fat

Brisket fat[1] is little used for dietary purposes as a separated fat, but relatively large amounts are consumed as a constituent of brisket which is quite generally sold in the form of "corned-beef." For the purpose of the experiments discussed above, a quantity of fresh briskets were purchased and the fat was separated from the connective tissue by the usual household procedure. In appearance the brisket fat was yellow, somewhat granular, slightly harder than butter and without noticeable characteristic flavor or odor. The brisket fat was incorporated in a special cornstarch blancmange and served as a part of the usual experimental diet. The data of the seven digestion experiments indicate that brisket fat is very completely utilized by the human body, being 97% digested. In these experiments where an average of 82 grams daily were ingested, brisket fat was well tolerated by all the subjects assisting in the investigation.

## Milk Fat (Butter and Cream)

Two series of digestion experiments were conducted to determine the digestibility of milk fat. In the first series, of eight experiments,

[1] U. S. Dept. Agri. Bul. 507 (1917), p. 8.

the milk fat was studied as a separate fat, namely butter[1], which was incorporated in the customary manner into the usual experimental ration. Often it is contended that the fat ingested in the form of an emulsion is more completely utilized by the human body than when it is taken as a separate fat, and to secure data in this connection a second series of digestion experiments were made in which milk fat was served in the form of cream[2]. This was incorporated into the diet in the same manner as butter and accordingly the two series of experiments should be directly comparable. In both instances the results of the individual experiments were close and the average values for the two series of experiments were the same, indicating a 97% utilization of milk fat when ingested either as cream or butter.

### Hard-Palate Fat

The hard-palate fat[3] studied in the experiments reported here was obtained by water extraction of hard-palates from the roof of the mouth of beef animals, secured from an abattoir shortly after they were removed from the animal. The hard-palates, which contain about 11% of fat, were minced and boiled for two or three hours and on cooling the extracted fat, which forms a solid cake on the surface of the liquor, was removed and scraped free of adhering particles, tissue, or other solids. Prepared in this manner it was yellow, slightly granular, without noticeable flavor, melted at 34° C, had an iodin number of 52.53 and a refracture index of 1.4586. The subjects who assisted in the digestion experiments with hard-palate fat maintained their normal physical condition during the experimental period, which gave evidence that hard-palate fat did not cause unpleasant physiological action. Judged by these digestion experiments, the digestibility of hard-palate fat, 94%, is less than that of brisket or milk fat.

### Kidney Fat

Ten digestion experiments were made to determine the digestibility of beef kidney fat[1]. On an average the subjects ate 100 grams of kidney fat daily, but in three experiments the subjects ingested an average of 130 grams, 137 grams and 151 grams daily for three consecutive days, without producing any laxative effect, which indicates that beef kidney fat is well tolerated by the human digestive tract. These results are in agreement with the quite general practice in some localities in Europe of the families of small means to eat rendered beef fat, "drippings," on their bread in place of butter. The digestibility of beef fat, 93%, as determined in the experiments reported here is identical with the result 92.8% reported by Flurin for the digestibility of beef tallow.

[1]U. S. Dept. Agri. Bul. 310 (1915), p. 14.
[2]U. S. Dept. Agri. Bul. 507 (1917), p. 11.
[3]U. S. Dept. Agri. Bul. 613 (1919), p. 8.

## Oleo Oil and Oleo Stearin

While there is relatively little commercial demand for beef tallow, there is an enormous demand for the softer fats and oils. Recognizing this demand the packing houses make a commercial separation of the harder and softer constituents of beef tallow into what is known in the trade as oleo oil and oleo stearin. Some oleo oil is consumed as a separated fat by persons who because of religious or dietary customs prefer it to other animal fat, but the larger part is used in the manufacture of oleomargarine. The oleo stearin, which is utilized for food purposes, is practically all used in the preparation of compounded culinary or table fats. For the purpose of the experiments reported here a supply of oleo oil and oleo stearin was secured direct from the manufacturer. The former was yellow, and barely solid at room temperature, while the latter was white, and very hard and both were without noticeable odor or taste. To determine the digestibility of these fats eight experiments were made with oleo oil[2] and three with oleo stearin[3]. Since the experimental conditions were identical for both series and two subjects assisted in both series, it may be interesting to note that with subject J.F.C. the digestibility of oleo oil was 12% higher than for oleo stearin and with subject T.G.H. the digestibility was 9% higher for oleo oil. The digestibility reported for olea oil is 97%, which is the same as that reported for butter. Contrasted with this figure is 80% reported for the digestibility of oleo stearin, which is the lowest figure that has been reported for any fat of animal origin.

## Ox-Marrow Fat

The product known in the trade as "Ox-Marrow" is prepared in the packing houses by sawing off both ends of the shank bones from the beef animals, heating them in water at about 160° to 170° F and blowing out the contents with compressed air. This crude product is processed and packed in cans.

Many investigators have studied the nature and composition of ox-marrow. Friedwald and Ruhrah[1] report the use of bone marrow, rich in fat, for treatment of tuberculosis and pernicious anemia, preference being given to marrow from young animals. Zink[2] found that yellow marrow fat consisted chiefly of olein, palmitin and stearin but it has a higher acetyl value than fats from other parts of the body. Forrest[3] concluded that red marrow contained two proteins, one a globulin, coagulating at 47-50° C, containing no phosphorus, and one a nucleo-albumin

[1]U. S. Dept. Agri. Bul. 310 (1915), p 8.
[2]U. S. Dept. Agri. Bul. 613 (1919), p 12.
[3]Idem., p 15.

containing phosphorus. Glikin[4] states that iron occurs in the bone marrow but decreases in amount as the animal increases in age.

For a long time particular dietetic and therapeutic potency has been ascribed to ox-marrow, but regardless of any special value that it may possess from a therapeutic standpoint, its large fat content is a source of energy. To secure data concerning the possible use of this energy by the body, four digestion experiments were conducted under the usual experimental conditions. The results of these experiments[5] indicate that marrow fat is not quite as well utilized as fats from other parts of the body and consequently does not yield as high an energy value. Furthermore, each of the four subjects, who on an average ate 59 grams of ox-marrow fat per day, reported physiological disturbances as a result of the ingestion of this fat. It is of course possible that the limit of tolerance for this particular fat had been exceeded and that had a smaller amount been consumed normal physiological processes would have followed.

## Ox-Tail Fat

Ox-tail fat, which is a common constituent of ox-tail soup, is to some extent separated and sold as a by-product of the packing industry. Correspondence with the packing houses supplied information to the effect that ox-tail fat was practically all utilized as an edible fat, either as a constituent of ox-tail soup, as a component of culinary fats, or as an ingredient of oleomargarine. The chemical and physical characteristics of the ox-tail fat procured for the purpose of the digestion experiments discussed were found to be iodin number 56.58, melting point 36.8°-37.0° C and index or refraction at 40°C 49.00. At room temperature it separated into solid and liquid portions, both of which were of a light yellow color and in the ratio of about four to one.

Three digestion experiments[1] were made to determine the digestibility of ox-tail fat and it was found to be 97% digested. On an average the subjects ate 77 grams daily with no indication of any physiological disturbances, indicating that this fat is a very efficient source of energy.

## Summary

The digestion experiments reported above were all conducted under like experimental conditions, thereby making possible a close comparison of the results obtained for the individual fats studied. The fats under

[1]Diet in Health & Disease. W. B. Saunders & Co., Phila. and London 1913, 4 ed., p 144.
[2]Chem. Zentbl., Vol. 68 (1897), No. 5, p 196.
[3]Jour. Physiol., Vol. 17 (1894-5), p 175.
[4]Ber. Deut. Chem. Gesell., Vol. 41 (1908), No. 5, p 910.
[5]U. S. Dept. Agri. Bul. 613 (1919), p 17.

[1]U. S. Dept. Agri. Bul. 613 (1919), p 19.

consideration were obtained from different parts of the body of cattle but due to the amount of fat required for even three or four digestion experiments it was impossible to use fats from only one animal.

In comparing the digestibility of fats from the different parts of the body it is interesting to note that brisket fat, butter, cream, and ox-tail fat were equally well absorbed, being 97% digested and hard-palate fat, kidney fat and ox-marrow fat were 94% digested. While the difference in digestibility, 97% to 94%, is not large, one can hardly avoid speculating as to why the animal body should produce fats as far as digestibility is concerned fall into two distinct groups.

None of the fats studied produced other than normal physiological reactions, except ox-marrow fat, but with this fat each of the four subjects experienced digestive disturbances as the result of the ingestion of 59 grams of ox-marrow fat daily, which would indicate that the limit of tolerance for this fat was much lower than for other beef fats. With the possible exception of ox-marrow fat, all the beef fats are very completely digested and are well tolerated by the human body.

# SOAP AS A DISINFECTANT AND ANTISEPTIC

By L. W. BOSART

Although considerable matter has been published from time to time showing that soap, besides being the universal cleansing medium, is a valuable disinfectant and antiseptic, this fact does not seem to be generally understood. It was thought to be worth while, therefore, to call attention to the results of some of the work which has been done in this connection.

Robert Koch[1] was the first to investigate this subject and to ascribe to soap a germicidal action. He was followed by Behring[2], Jolles[3], Serafini[4], Rodet[5], Rasp[6], Reichenbach[7], Lamar[8] and Nichols[9], all of whom found soap to be definitely germicidal.

John E. Walker[10] of the Army and Navy General Hospital at Hot Springs, Arkansas, has carried out some very thorough work on soaps made from the individual fatty acids which occur in ordinary soap. His work shows soap to be a very powerful germicide, much stronger, on the whole, than carbolic acid.

H. G. Elledge,[11] who worked in connection with the Laundryowners' National Association at Mellon Institute, says that he has demonstrated that soap, even in water at 40°C, in concentration equal to that employed in washing woolens, has a bactericidal efficiency of 98 per cent for all the common pathogenes.

Again Elledge and McBride[12], in reporting the results of their investigations of the effect of washing on the sterility of clothes, say that the washing with soap produces a bactericidal efficiency comparable to that obtained by pasteurization. In their tests the washing was done at 40°C, so that the bactericidal action was not due to high temperature but to the soap solution itself whose strength was considerably less than one per cent. A laboratory model of the usual type of commercial washing machine was used.

Dr. Pilod[13] conducted investigations on the ordinary cake of soap. He found that soap was not only sterile itself but did not offer a favorable medium for the development of bacterial cultures. Pilod used soap which lay in the operating room or had been kept in the laboratory without special precautions. He says that soaps are originally sterile both on account of their chemical composition and their method of manufacture.

A little consideration of the method ordinarily employed in soap making will show that this must necessarily be the case. Fats themselves, if reasonably pure, that is, free from moisture and organic impurities, do not furnish a medium on which micro-organisms can propagate. (Animal fats especially are made completely sterile in the process of rendering.)

This is also the case with strong caustic solutions which are combined with fats to make soap. The latter are strongly germicidal even when cold. It will be seen, therefore, that the materials of which soap is made must be comparatively low in micro-organisms when they enter the kettle to be boiled. If, in addition to this, it is considered that the soap is heated to a high temperature and ordinarily kept hot over a period of several days, it must necessarily be sterile as it comes from the kettle.

Pilod summarizes his work as follows:

"Sodium soaps are originally sterile both because of their chemical composition and because of their mode of production. While this sterility is easily maintained in the inside of the cake, its outer surface is always exposed to soil. If in spite of this it remains aseptic, this is for the reason that soap prevents the development of germs, which quickly die in contact with it, with the exception, however, of the spores which can keep for a long time on the surface of the soap but without undergoing further developments. In spite of this limitation, it is unnecessary, according to our view, to sterilize soaps by heating them before use, but it is sufficient to rinse off well the outer surface of the soap in order to carry away mechanically any spores which may have settled there. This simple expedient will suffice to restore to the soap its original sterility."

With regard to the use of soap for treating wounds, we would call attention to a paper published by Dixon and Bates[14] in the *Lancet* in 1917. These surgeons treated wounds with a 2½ per cent solution of common yellow soap and dressed the wounds with sterile gauze soaked in this solution. They state that the wounds healed up quickly and the dressing caused much less pain than ordinary dressing. Haycraft[15] also used soap solutions with great success during the World War. Superficial wounds were completely excised and the soap solutions were rubbed into the surface; they were then stitched up. He found that deep wounds with compound fractures healed better with the use of soap solution than with ordinary antiseptics. For four months previous to the time of writing he had been using soap solution in all cases where it was possible.

It is not desired to urge, at this time, the use of soap as a general antiseptic, nor to claim that it is a specific against all manner of pathogenic germs. The subject is one, however, which is worthy the consideration of physicians and those interested in first aid treatment, for soap and water are materials that are always close at hand and can be had in almost any emergency.

The treatment of wounds with soap and water is so natural and simple that it should come into more general use, if thorough trial proves it to be as satisfactory as the experience of the English surgeons would indicate.

From the foregoing, the conclusions may be drawn that soap is, from

the very nature of the material used in its manufacture and the process by which it is made, a sterile substance; aside from this, it is a powerful disinfectant; it is a sanitary and efficient medium for the cleansing of soiled and infected clothes; it appears to be a very satisfactory material in the treatment of wounds to clean them and keep them in a sterile condition.

---

[1]Mitt. a.d. Kaiserl. Gesundheitsamt, 1881, *1*, 271.
[2]Zeitschr. f. Hg. u. Infektionskrankh, 1890, *9*, 414.
[3]Zeitschr. f. Hg. u. Infektionskrankh, 1893, *15*, 460.
[4]Zeitschr. f. Hg. u. Infektionskrankh, 1898, *19*, 130.
[5]Arch. f. Hyg., 1898, *33*, 369.
[6]Rev. d'Hygiene, 1905, S. 301.
[7]Zeitschr. f. Hyg. u. Infektionskrankh, 1908, *58*, 45.
[8]Jour. Exp. Med., 1911, *13*, 386.
[9]Jour. Lab. & Clin. Med., 1920, *5*, 502.
[10]Journal of Infectious Diseases, 1924, *35*, 557-566.
[11]Scientific American Supplement, 1917, *84*, 30.
[12]American Journal of Public Health, Volume 8 (1918), 494.
[13]La Presse Med., 1912, No. 16.
[14]Treatment of Wounds by a Solution of Soap in the Casualty Clearing Station, by Captains R. G. Dixon and H. T. Bates. Casualty Clearing Station, B. E. F. France.—The Lancet, 1917, Part II, p. 789.
[15]On the Treatment of Gunshot Wounds with a Solution of Soap and Water and Primary Suture. by Capt. J. B. Haycraft, Surgical Specialist. Casualty Clearing Station.—Brit. Med. Journal, 1918, Part I, pp. 80-82.

## OIL FROM SEED CURES LEPROSY

The definite eradication of leprosy as the result of the discovery of a tree, the properties of which are said to cure the disease, is predicted in the report of the British Empire Leprosy Relief Association for last year, which was published on January 18. A passage in the Leprosy Society's report reads as follows:

"Leprosy was formerly regarded as incurable, but recent researches have led to the discovery of methods of treatment which, if given at a sufficiently early stage, will cause the disappearance of all signs of the disease. It is now certain that leprosy can be eradicated from any country where adequate arrangements are made for the proper treatment of all persons contracting the disease."

The report says that D. E. E. Muir, of the Calcutta School of Tropical Medicine, discovered that pure oil from the ripe seeds of the Southern Hydnocarpus wrightiana was as efficacious as ethyl esters, which are now used and which cost at least ten times as much. This tree is said to thrive in all tropical countries.

The report states that the largest number of recoveries from leprosy effected in the British possessions have been obtained by Americans.

# THEORY OF EMULSIONS AND EMULSIFICATION

BY P. M. TRAVIS

For the past twenty years emulsions have been the subject of lively comment in chemical literature, and while no general theory for emulsification has been elucidated, many have been proposed from time to time, only subsequently to be shown to apply to special causes. There is, however, a mass of arbitrary data which can be profitably applied.

*Definition:* An emulsion is a system containing two liquid phases, one which is dispersed as globules in the other. That liquid which is broken up into globules is termed the dispersed phase, while the liquid surrounding the globules is known as the continuous phase or dispersing medium. The two liquids which must be immiscible or almost so, are frequently referred to as the Internal and External phases respectively, or expressed in another way. An emulsion is a mixture of two or more fluid bodies which are not soluble in each other, but kept in suspension by mechanical means. The finer the division of the particles, the better they serve the purpose they are intended for. If these particles can be divided so finely that they approach in form a colloidal state, then they will not separate on standing.

Of recent years, so-called colloidal solutions have formed the subject of numerous investigations, and are of great practical importance in both medical and industrial chemistry. These solutions were formerly known as pseudo-solutions. In true solutions, the particles are in the molecular or ionic state. The particles in collodial solution are on the whole larger aggregates than in true solution, and the similarity to a fine emulsion is very close.

In the case of an emulsion where oil and water are used, we speak of it as an oil-in-water emulsion or a water-in-oil emulsion. In the case of the oil-in-water emulsion, the oil is dispersed in the water, the water being the continuous phase, while in the water-in-oil emulsion, the reverse is the case.

Clowes[1] found that sodium, potassium and lithium soaps emulsify oil in water, while magnesium, strontium, barium, iron and aluminum soaps emulsify water in oil. The first series of soaps contain monovalent metals and are soluble in water but not in oil while the second series contain bi and tri valent metals and are soluble in oil but not in water. In other words, alkali soaps are wetted more by water than by oil, and probably the surface tension is lower on the water side than on the oil side of the globules, so the film will bend convex to the water and concave to the oil, enveloping the oil globules, as the area of the inner surface of a sphere is less than that of the outer. Similar reasoning holds for the

reversing of the emulsion by the other soaps mentioned, which are more soluble in the oil. Examples of both types of emulsions are as follows:

### Water-in-Oil Emulsions

Calcium and aluminum soaps are used in lubricating greases. They are, as a rule, solutions of lime soaps (15 to 25 per cent) in heavy mineral oil with 1 to 4 per cent water emulsified in them. Some lubricating greases for automobile use consist of aluminum soaps dissolved in mineral oils with water emulsified in them by the aid of rosin.

### Oil-in-Water Emulsions

The most common emulsions are those in which the oil is dispersed in the water or oil-in-water emulsion. In all emulsions where the concentration is over 2% it is necessary to have a third substance present, which is known as the emulsifier or emulsifying agent. For example; in the case of dairy emulsion, such as butter fat dispersed in milk, casein is the emulsifying agent, while in the case of a chocolate emulsion the cocoa fat is emulsified in the chocolate liquor, fine particles of cocoa powder which accumulate about these fine globules of cocoa fat are the emulsifying agent.

**Water-Soluble Colloid as Emulsifying Agent:** Good emulsifiers of this class are sodium and potassium soaps, egg albumin, gelatin, glue and other water-soluble proteins, gum arabic, Irish moss, casein, starch, saponin and various bark extracts.

NaOH was classified as an excellent emulsifying agent for fatty oils in water, but Donnan's[1] investigation showed that its emulsifying powers were really due to the soap formed by interaction with the small amount of free fatty acid that is always present in fatty oils.

There is a very simple method of determining the type of emulsion. Upon addition of water to an emulsion of oil-in-water it will disperse. Similarly, a water-in-oil emulsion will mix with oil. In short, an emulsion will mix with more of its external phase, but not with internal phase.

**The Electric Charge:** The oil globules in emulsions of oil-in-water carry a negative charge, as proved by cataphoresis tests. The origin of this charge is still open to question, as is, indeed, the more general case of the electric charge of all colloid particles.

The electric charge is believed to be due to the absorption of ions. In the case of emulsions bearing a negative charge, absorption of OH ions at the surface of the oil globules is postulated. Even when emulsions are made with absolutely pure oil and pure water there should be present hydrogen and hydroxyl ions due to the ionization of the water, and consequently absorption of OH ions.

**The Stability of Emulsions:** We have already noted that con-

centrated emulsions demand the presence of an emulsifying agent. In such cases the stability of the emulsion depends on factors relating to an absorbed film at the oil-water boundary.

Pickerling[1] noted that emulsions were poor conductors of heat. It is possible to boil a beaker of such an emulsion for several minutes, while the center remains at less than 100° C. When kept in closed vessels they are permanent for months.

The absorbed ions are considered to be concentrated near the surface of the globules, in the layer of the liquid immediately bathing the globules.

The two layers of oppositely-charged ions are frequently referred to as the Helmholtz double layer. The oil globule and its double layer may be considered as a small condenser, a definite potential difference existing between the oil and the nearer ionic layer. Such a system should be self-contained and electrically neutral to an external field, and for this reason a certain "facility of slip" between the nucleus and the outer ionic layer since the oil globules in emulsions wander to the anode in an electric field, thus giving proof that they are negative. The fact that the dispersed particles do carry an electrical charge is most important when we come to the question of the stability of any emulsion.

**Brownian Movement in Emulsions:** Suspensions of fine particles, fine-grained emulsions, and colloidal solutions of metals all show when examined under the ultra-microscope, that the particles of the dispersed phase are in continuous zigzag motion. The phenomenon is termed the Brownian Motion, after Brown[2], who studied the movements of pollen grains in water. It is now known that the movement of finely divided particles suspended in liquids are due to the bombardment of the particles by the molecules of the surrounding liquid. This Brownian movement is not observed before the particles are split to a very finely divided state; usually below 2 u in size.

**The Viscosity of Emulsions:** The position regarding the viscosity of emulsions from a quantitative point of view is far from satisfactory, very little work having been done in this connection. Dilute emulsions show a viscosity not much greater than that of water. Viscosity increases rapidly as the volume of the dispersed phase increases, but in this case, of course, there arises the new factor of the emulsifying agent.

The viscosity of concentrated emulsions is intimately connected with the presence of absorbed films around the dispersed globules. This is particularly so in the homogenization of emulsions, i.e., the increased dispersion of the internal phase, whereby the presence of the absorbed

emulsifying agent at the greatly magnified interface confers a marked increase of viscosity to the system.

**Stability:** For emulsions of oil in pure water the stability is influenced by (a) the interfacial tension, tending to bring about coalescence of the globules, whereby the total surface would be reduced (b) the Brownian movement, tending to collision of the globules, a factor against stability; and (c) the electric charge on the globules, tending to repel them on near approach.

Most of the work on emulsion stability relates to the influence of added electrolytes. When colloid particles are coagulated under the influence of electrolytes, the globules absorb oppositely-charged ions, so their charges become neutralized and at the isoelectric point, where the potential difference between the particles and the medium become zero, stability is least.

The work of Donnan[1] on neutral oil emulsions shows that there is a close similarity between such "mechanical" emulsions and colloidal suspensions. In each the particles carry an electric charge of the same order of magnitude, the limiting grain size is similar, the potential difference values are similar, and the condition for stability under the action of absorbed ions are also similar. Thus the electrical factors outweigh the effect of interfacial tension.

The preparation of stable emulsions on a commercial scale is best carried out by use of a machine known as a homogenizer. This is usually a pressure type of machine which operates at pressures of from 3,000 to 4,000 lbs. per sq. in. In recent years, however, other types have appeared on the market and in some cases the pressure type has been replaced by a high speed type in which the dispersion is brought about by a shearing action.

## Homogenizers

The first uses of the homogenizer were confined to the Diary Industry and dates back to about 1905, when they were first introduced for the Homogenization of Dairy Products, such for example as Evaporated Milk, and for all uses where they did not wish the cream or fat to separate. Therefore, its purpose was just the reverse of that of a Cream Separator. Instead of separating the fat from the milk it was possible with the homogenizer to incorporate fat into the milk, thereby making any percentage of cream desired up to as high as 40%, or what is known as heavy cream.

After the homogenizer had worked successfully in this field for a few years, it was next introduced into the Ice Cream Industry, where its use obviously was to incorporate the fat, milk solids, etc., into a homogenous mass, and develop a smooth ice cream, gel, etc., which brought about a big improvement in the manufacture.

The practice of homogenizing was confined to the two industries just mentioned for a great number of years, and it is only fairly recently that machines have been perfected capable of making fairly perfect emulsions of oils, fats, etc., with water.

The present generally accepted theory of the formation of homogenized emulsions postulates the presence of a stabilizing film around the dispersed phase which prevents the particles from coalescing when they come in contact with each other, due to the Brownian motion. This protecting film is the colloid or emulsifying agent used, which surrounds each particle of the dispersed phase of the emulsion. As these particles are so finely broken up that they take on Brownian "motion" they are, of course, not affected by gravity so much.

**Change in Size of Fat Globules:** Wiegner[1], in his studies on homogenized milk, investigated the change in the diameters of the fat globules and the increase in their numbers following homogenization.

It is of interest now to mention the globule sizes of some typical three-phase emulsions for the purpose of comparison. Baldwin[2] found that the butter fat globules in cow's milk were from 0.005 to 0.006 mm. diameter (5 to 6 u). By homogenizing—i.e., further sub-dividing—the globules, the diameters were reduced to 1 or 2 u.

It is of interest to know that according to the tables, that the diameter of the fat globules have been reduced from 2.86 u. to 0.27 u. and from 2.94 u. to 0.17 u., the sample with the smaller fat content being split into a finer state of division.

The number of particles in the first sample has increased 1,188 times and in the second sample 1,258 times, after homogenization. The surface area of the fat globules has been increased 112 and 117 times, respectively. The viscosities of 1 : 1.12 and 1 : 1.15, respectively. There was no apparent change in density and no difference in electrical conductivity, though Buglia[1], in similar work, noted a slight increase in the electrical conductivity of homogenized milk. Both Wiegner and Buglia find that there is a slight increase in osmotic pressure following homogenization.

NEW YORK, N. Y.
September, 1925.

---

Note: The foregoing paper was delivered in the form of an address before the students' course of the Tenth Chemical Exposition, Grand Central Palace, New York, on September 28.

# NOVEMBER IMPORTS OF OLIVE, PEANUT AND COCOANUT OILS

Preliminary estimates of imports of Olive, Cocoanut and Peanut Oils, compiled by the Department of Commerce, show the following totals for the month of November, 1925:

OLIVE OIL, EDIBLE

| Countries | Peanut oil | | In packages less than 40 pounds | | Other | |
|---|---|---|---|---|---|---|
| | Pounds | Dollars | Pounds | Dollars | Pounds | Dollars |
| France | 156,110 | 18,882 | 166,193 | 26,987 | 575,704 | 98,962 |
| Germany | .... | .... | .... | .... | 22,825 | 4,753 |
| Greece | .... | .... | 76 | 10 | 18,493 | 2,835 |
| Irish Free State | .... | .... | 5,352 | 750 | .... | .... |
| Italy | .... | .... | 3,201,100 | 599,511 | 517,772 | 97,848 |
| Netherlands | 19,989 | 2,648 | .... | .... | .... | .... |
| Spain | .... | .... | 130,144 | 25,108 | 1,355,484 | 232,861 |
| Switzerland | .... | .... | .... | .... | 24,118 | 8,137 |
| Turkey in Europe | .... | .... | .... | .... | 1,507 | 268 |
| United Kingdom | .... | .... | .... | .... | 126 | 51 |
| Canada | .... | .... | 3,170 | 564 | .... | .... |
| China | 8,100 | 1,186 | .... | .... | .... | .... |
| Hongkong | 96,730 | 16,568 | .... | .... | .... | .... |
| Japan | 76 | 11 | .... | .... | .... | .... |
| Palestine and Syria | .... | .... | 288 | 55 | 289 | 28 |
| Italian Africa | .... | .... | .... | .... | 3,029 | 453 |
| Total | 281,005 | 39,295 | 3,506,323 | 652,985 | 2,519,347 | 446,196 |

| Countries | Cocoanut Oil | |
|---|---|---|
| | Pounds | Dollars |
| Italy | .... | .... |
| United Kingdom | 55,522 | 6,479 |
| Dominican Republic | 250 | 18 |
| Haiti | 217 | 15 |
| China | .... | .... |
| Hongkong | .... | .... |
| Japan | .... | .... |
| Philippine Islands | 21,991,357 | 1,966,105 |
| Total | 22,047,346 | 1,972,617 |

# FURTHER PROCEEDINGS OF THE SIXTEENTH ANNUAL CONVENTION

Lack of space prevented completing the record of the proceedings of the Sixteenth Annual Convention in the last (October, 1925) issue of the *Journal*. Two remaining committee reports are of such importance as to make their publication highly desirable, in spite of the late date. These are reports by the Moisture Committee and the Seed Committee. Also resolutions were passed that must at least be made a matter of record—THE EDITOR.

## THE REPORT OF THE MOISTURE COMMITTEE

By P. S. TILSON

The work of this Committee began where Drs. G. L. Bidwell and W. F. Sterling, Bureau of Chemistry, Washington, D. C., left off in respect to Cottonseed Meal and this report includes much of the article on "Direct Moisture Determination" as given by Bidwell and Sterling in "Industrial and Engineering Chemistry," Volume 17, No. 2.

Briefly, this method for determining moisture is to distill the sample with a liquid, toluene, which is immiscible with water. The apparatus used and the method of procedure is essentially that described in the Bidwell and Sterling article.

### Disadvantages

The tubes require thorough cleansing before each determination, and the condenser should be cleaned once for every two or three determinations. Otherwise it is necessary to brush down the condenser so that the water will flow to the bottom of the tube as it should.

Water of crystallization is separated from some substances, as copper sulfate, sodium sulfate, etc.

Several substances, such as alcohol, glycerol, acetone, etc., which are volatile and miscible with water, may distill over and cause high results by this method.

### Advantages

The method determines water directly, and the results are actual water and not loss in weight.

As the substances mentioned above, which are volatile and miscible with water, are more or less soluble in toluene, the results by this new method are more accurate than results given by an oven method.

The results are obtained in most cases within an hour, and in all cases in much less time than a working day.

No complicated, expensive apparatus is required. The tubes can be made by any glassblower and should be comparatively inexpensive if manufactured in quantity. The other parts of the apparatus are found in every laboratory. The tubes will cost about $1.25 each.

The effect of humidity during the determination is eliminated.

The method prevents oxidation of the sample while the moisture is being determined.

No special training in technic is required for manipulation as several analysts unacquainted with the method were able, after simple explanations, to obtain entirely satisfactory results at the start.

### Discussion

The moisure apparatus used did not exactly meet the required specifications being the first apparatus made by the manufacturer.

Your Committee knows of no other analytical process in which we are concerned that needs greater special attention as shown by our moisture results on check meal work, and it also shows conclusively that many of our laboratories are not equipped with a constant and uniform moisture oven.

In using this moisture apparatus the Committee confined its attention to Cottonseed Meal. Since the results were few, and the apparatus used requires a slight modification, your Committee does not feel justified at this time in giving its results in detail. However, they are available to any one interested.

The results obtained show that two analysts can check much more closely with the Bidwell Sterling apparatus than they can by use of the present laboratory ovens.

The greatest value of the Bidwell-Sterling method is that it arrives at the true moisture content, thus enabling the analyst to see how close his oven method is to being correct. If our study in connection with the Bidwell-Sterling method enables us to ascertain whether or not our laboratories are equipped with a uniform and constant moisture oven, we have accomplished much.

The Committee sees great merit in the Bidwell-Sterling moisture apparatus and recommends that all participants in check meal work be required to report moisture once a month by both methods, and that the Bidwell-Sterling moisture method be further studied by a Moisture Committee, particularly in reference to moisture content of all substances of direct interest to the American Oil Chemists' Society.

*Committee*: P. S. TILSON, Chairman; E. C. AINSLIE.

## A CORRECTION

"Mr. H. C. Moore, Chairman of the Ammonia Committee, American Oil Chemists' Society, wishes to announce that in his report published in the October issue of this journal the results of analyst No. 48 were omitted. This result should appear in table No. 2, page 121, and is tied for third place with analyst No. 74."

# A PRELIMINARY REPORT OF THE PLANNING COMMITTEE

By David Wesson, Chairman

With the beginning of the season's crop of cotton seed, the various Committees of the American Oil Chemists' Society has started to work in good earnest. Dr. P. S. Tilson, Chairman of the Moisture Committee, reports the contemplation of a very extensive investigation of the Bidwell-Sterling moisture method. This method promises to be the one which has long been looked for to give accurate results in the determination of moisture in cotton seed products.

H. C. Moore, Chairman of the Ammonia Committee, is sending out samples of meal in connection with the work of the Smalley Foundation. This work has been progressing actively throughout the season.

C. B. Cluff, Chairman of Refining Test Committee, suggests the following work for the coming season:

1. Samples representing one or preferably two lots of settled crude oil of the kind usually difficult to refine and requiring longer agitation, should be sent out to members of the committee. This should be done in September, if possible.

2. Two samples of ordinary crude oil not settled should be sent out to committee members, in October.

3. If the above tests show reasonable agreement among members, one sample of settled crude and one of unsettled crude should be sent out in November or December, to all members of the committee and at least five other chemists closely connected with refining work.

4. The results of the above tests, which should be completed by the end of December will determine our future course.

The general refining procedure is to be the same as used last season.

The colors of all refined oil samples to be read in one central laboratory to eliminate personal differences. The lyes which will be specified for use on the above samples are to be taken from the schedule contained in my letter of July 3rd.

Crude oil for these tests should be selected so that it will not be of too good quality. F.F.A. should be about 2½ per cent to 4 per cent, if possible.

D. C. Picard, Chairman of the Seed Committee, states that his committee is endeavoring to work out a practical method that will apply to seed under all conditions—wet or dry—and one that will involve a minimum of manipulation. If we use gaseous hydrochloric acid on the first seed of the season, we would have to dry the seed afterwards in order to get it in condition to grind and there is no advantage in doing that. If we treat normal seed with gaseous acid as a preliminary treat-

ment to removing all the lint by rubbing or shaking, we would have to weigh the delinted seed to figure results back to the original seed and you have no idea how easy it is to lose a few seed in manipulation. In the Malowan method twenty to fifty seed can be handled a day if there is sufficient oven capacity and with the mill properly regulated, only about five minutes will be needed to prepare each sample for analysis after the seed have cooled. There is no weighing of seed before or after treatment and all calculations are figured on the moisture basis, therefore, after the seed are treated and prepared, the remainder of the work is routine.

L. F. Hoyt, Chairman of the Sub-Committee of the A.C.S. on the Determination of Detergancy of Soap Products, reports progress on a standard method which is now being studied by the members of his committee. Special apparatus has been designed and the method has been standardized. It is belived we will find that with progress already made the final report will show that a thorough practical method has been worked out.

## REPORT OF THE SEED COMMITTEE

The Seed Committee continued the work of its predecessors and worked on improvements of the Malowan method besides sending out seed samples to several chemists to obtain a better try-out of the method.

The following laboratories co-operated with your committee: Barrow-Agee Laboratories in Memphis, Tenn., Shreveport, La., Greenville, Miss.; Houston Laboratories, Houston, Tex.; Houston Cotton Oil Mill, Houston, Tex.; Law & Co., Atlanta, Ga.; Picard Laboratories, Birmingham, Ala., and the Portsmouth Cotton Oil Refining Corporation, Portsmouth, Va.

Seed Sample No. 1 was analyzed by the following two methods: (Method A was proposed by the Seed Committee of last year and method B is an improvement worked out since.)

**Method A:** Take approximately 50 grams of the sample and moisten for 2-3 minutes with HCl (2 parts acid to 3 parts water). Drain off the liquid and dry the sample at about 130 C. for two hours, or long enough to reduce the moisture to a maximum of 3 per cent. Allow the sample to cool and then grind in a mill or mortar to a degree of fineness that allows of thorough mixing.

**Method B:** Place into a 150 or 250 cc beaker 3 to 5 cc. conc HCL and insert a crucible cover to keep the seed of the acid and add about 50 grams of seed without packing. Cover with a watch glass and heat in an air bath, oven, or hot plate for about ten minutes, then remove watch glass and continue heating for about 30 minutes till seed are dry. Empty the beaker and permit to cool, then grind the seed and mix.

**Oil:** Take four or five grams of the ground seed and extract for two hours, then re-grind sample in mortar and extract two hours longer. Ammonia: Take the ground seed and use the same method as for meal. Moisture: Use the official method for moisture in the original seed and make a moisture determination in the ground seed.

Take the difference of moisture between the original seed and the ground seed into consideration to figure out the oil and ammonia content of the original seed.

The results obtained on Check Seed No. 1 were as follows:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Moisture in Original Seed ..... | 9.00 | 8.03 | 7.59 | 8.90 | 7.92 | 7.93 | 7.75 | (e) |
| Oil in Original Seed. by method A..... | a19.09 | a18.38 | 17.98 | .... | 19.45 | .... | 19.14 | .... |
| | b18.26 | b18.25 | .... | .... | .... | .... | .... | .... |
| NH3 in Original.... Seed by method A.. | a4.39 | a4.26 | 4.25 | .... | 4.45 | .... | 4.38 | .... |
| | b4.20 | b4.23 | .... | .... | .... | .... | .... | .... |
| Moisture in Ground Seed by Method A.... | 2.51 | 4.81 | 1.50 | .... | 1.55 | .... | 5.40 | .... |
| Oil in Original Seed by Method B.... | 18.74 | 18.51 | 18.77 | 18.90 | .... | 18.69 | 21.57 | 18.70 |
| NH3 in Original Seed by Method B.... | 4.27 | 4.27 | 4.42 | 4.31 | .... | 4.37 | 4.19 | 4.21 |
| Moisture in Ground Seed by Method B.... | 7.00 | 6.77 | 9.07 | 2.68 | .... | 7.48 | 6.86 | (e) |
| Results by other.... Methods ..... | c18.26 | 18.33 | .... | 18.70 | .... | 18.72 | .... | .... |
| | d18.59 | .... | .... | .... | .... | .... | .... | .... |
| | 4.45 | 4.33 | .... | 4.06 | .... | 4.19 | .... | .... |
| | C | C | .... | D | .... | D | .... | .... |
| Did you use the Malowan Method before? ..... | yes | yes | yes | no | no | yes | yes | yes |
| What Method do you use? ..... | A | A&C | A | D | E | D | D | .... |

Notes: A.—Malowan Method A, described above.
C. Grinding 10 grams untreated seed in mortar, extracting twice.
D.—Smalley-Copes Method.
E.—Official Method of Georgia C. S. Crushers' Association.

a. Results figured according to methods A & B.
b. Results figured from actual loss in weight of seed during treating and drying. Seed were weighed before treatment and before grinding.
c. Method C, extracting twice with one re-grinding.
d. Method C2, extracting three times with two regrindings.
e. No moisture determinations were made; but as oil and ammonia results agree with average, it can be assumed that the moisture in the treated seed did not vary much from moisture in the original seed.

The results agree quite well, although several chemists had no previous experience with the methods. Considering that method B is much easier to manipulate, besides giving better results, it was decided to discontinue experiments with method A. Mr. Picard modified the method B by using portions of exactly 10 grams instead of using about 50 grams.

Check Seed Sample No. 2 was run according to method B with the remark that neither the watch glass nor the crucible cover is required, but that too high a temperature in drying the seed should not be used and that the seed, which stuck to the container or have become dark brown should be discarded and not be ground. Method C is the Picard method

of treating and drying 10 grams, grinding in a mortar, extracting for three hours, re-grinding and re-extracting for two additional hours. For ammonia the double factor weight of the original seed is taken.

Results of Check Seed No. 2

| | | | | | |
|---|---|---|---|---|---|
| Moisture in Original Seed | 7.88 | 8.70 | 8.65 | 6.40 | 8.96 |
| Oil in Original Seed, Method B | 19.60 | 19.18 | 19.27 | 19.11 | 19.26 |
| Ammonia in Original Seed, Method B | 4.29 | 4.03 | 4.26 | 4.24 | 4.21 |
| Oil, Method C | 18.87 | 18.68 | 18.89 | .... | 18.84 |
| Ammonia, Method C | 4.06 | 4.04 | 4.10 | .... | 4.24 |
| Copes Bag Method, Oil | 19.06 | .... | .... | .... | .... |
| Copes Bag Method, Ammonia | 4.24 | .... | .... | .... | .... |

The results on this sample agree again quite well by either method, but there is a difference of 0.38 per cent between the results by the two methods.

A great disadvantage of the Malowan method is that a part of the seed become partly charred on the outside and it is necessary to separate the dark colored seed before analysis.

Some tests were made to determine the difference between the light colored seed and the dark colored seed. Twelve seed samples were treated and dried at 140 to 150 C. for one half an hour and the four most discolored samples taken for the test. Each sample was separated into a dark colored and a light colored portion and each of those portions weighed, ground and analyzed with the following results:

| Weight of portion | | Oil found in | | Average oil figured from |
|---|---|---|---|---|
| light | dark | light | dark | oil and weight |
| 30.3 | 13.6 | 19.86 | 21.01 | 20.21 |
| 33.6 | 19.6 | 19.61 | 20.60 | 19.97 |
| 28.2 | 14.9 | 17.97 | 17.94 | 17.96 |
| 26.3 | 15.7 | 19.18 | 19.86 | 19.43 |

If we consider that the oil found in the light colored portion represents the true oil content of the seed, then the maximum error would be about 0.35 per cent of oil. In the actual determination the possible error would be less because according to the method the dark colored seed ought to be discarded.

Several experiments were made to find out the causes of charring of the seed and ways to eliminate same. It was found that it is not the temperature by itself, nor the action of the hydrochloric acid; but it is the combined action of the aqueous HCl and high temperature which causes charring. This suggested three means to prevent charring, first: to lower the temperature; secondly: to reduce the amount of acid; and thirdly: to prevent the contact of seed with moist acid. The temperature cannot be reduced below 120 C. without prolonging the time of drying excessively. The acid can be reduced to 1 to 2 cc. and the contact of moist HCl with the seed can be prevented by using gaseous HCl or by preventing the condensation of the acid on either the walls of the vessel or on the seed.

Two methods have been worked out based on the above principles. Both methods use 1 to 2 cc. of acid; but in the one method the seed are dried in a beaker at 120 C., while in the other method the seed are treated in a funnel with the stem cut off short and dried at 130 to 140 C. In the latter case the funnel and the seed become hot before the acid begins to boil and therefore no condensation takes place.

Several tests were made to determine whether there is any loss in weight during treatment besides the one caused by the loss of moisture. Twenty gram portions of seed were treated and dried under various conditions and then placed into the regular moisture oven with other portions of untreated seed and weighed after five hours drying. If the latest two methods were used, the final weights of the treated and untreated seed were practically alike, showing that these methods give correct factors for the calculation of the oil and ammonia content in the original seed.

| Untreated Seed 5 hours in Moisture Oven | Treated Seed After treatment five hours in Moisture Oven | | |
|---|---|---|---|
| % Dry Seed | % Dry Seed | Method of Treatment | |
| 91.71 | 89.14 | ¾cc. HCl. 45 min. at 120C. | beaker without filter plate |
| 91.71 | 89.24 | ¾cc. HCl. 45 min. at 130-140C. | beaker without filter plate |
| 92.32 | 91.54 | ¾cc. HCl. 45 min. at 110-115C. | beaker without filter plate |
| 91.10 | 90.80 | ½cc. HCl. 30 min. at 120-145C. | beaker with filter plate |
| 91.10 | 90.85 | ½cc. HCl. 45 min. at 120-140C. | beaker with filter plate |
| 91.40 | 91.40 | ½cc. HCl. 30 min. at 120C. | beaker with filter plate |
| 91.07 | 90.70 | ½cc. HCl. 30 min. at 130-145C. | beaker with filter plate |
| 91.07 | 91.13 | ½cc. HCl. 30 min. at 130-145C. | beaker with filter plate |
| 91.07 | 90.85 | ½cc. HCl. 30 min. at 120C. | beaker with filter plate |
| 90.90 | 90.35 | ½cc. HCl. 30 min. at 120C. | beaker with filter plate |
| 90.90 | 90.88 | ½cc. HCl. 30 min. at 140C. | Funnel |
| 90.90 | 90.45 | ½cc. HCl. 45 min. at 140C. | Funnel |
| 90.90 | 91.23 | ½cc. HCl. 30 min. at 120C. | Funnel |

To determine whether substances are formed during treatment which may be weighed as oil samples of hulls were treated like seed and no increase in the oil content could be noticed.

It has been noticed that sometimes no additional oil is extracted after re-grinding which would show that the dried seed can be ground in a suitable mill fine enough that it is possible to dispense with the re-grinding.

The last improvements were developed so late that it was impossible to have some seed samples ran by the collaborators by those methods; but same were thoroughly tested by the seed committee and it was found that the results by either method agree very well with those obtained by any other method.

A description of the two methods was sent out with a questionnaire to those chemists who did the co-operative seed work and answers were received. The questionnaire was as follows:

Are you in favor of having the method using about 50 gram of seed adopted?

Are you in favor of having the method of using 10 gram of seed adopted?

Are you in favor of having both methods adopted, leaving it to the chemist to choose either method?

Are you not in favor of having either method adopted?

Are you in favor of any other method?

The answers received were as follows:

C. W. Putland: I prefer the method using 50 grams to the one using 10 grams. I am not in favor of having both methods adopted. I have not done sufficient samples to judge accuracy of the method. Believe it should be tentatively adopted for one year and given a thorough trial.

B. L. Caldwell: I am in favor of the 50 gram method and opposed to the 10 gram method; but, I favor permitting a chemist to use both methods if he is satisfied with a 10 gram basis. My only objection to the second method is the smallness of the sample. I think the 50 gram method much better than the present Copes bag method.

J. R. Mays: We do not feel that we have had sufficient experience with either of the two methods yet. However, we believe that they are worthy of further study. We are not yet qualified by experience with the two methods to state whether they should be adopted or not.

P. S. Tilson: I am in favor of having both methods adopted, permitting the chemists to use either method.

G. Worthen Agee: We are in favor using the 50 gram method and not in favor of the 10 gram method for the reason that too small a weight of seed is used. We think that not less than 50 grams of seed should be treated. We see no advantage whatever in the method if small samples are used. We might add that in our experience, if the seed are reasonably dry when ground and are ground in a suitable mill, regrinding is not necessary.

Considering the results obtained and the answers received the Seed Committee believes it can propose the following method for cotton seed analysis for adoption.

## Proposed Method for the Analysis of Cotton Seed

*Preparation of Sample and Determination of Impurities:* Pass the whole sample through a one-half inch sieve to separate the seeds from possible clusters of a similar kind. Then shake on a six mesh sieve to remove sand and dirt. For the determination of impurities, which can

be made at this point, shake a weighed portion on a sieve to remove sand and pick out the bolls and trash, weighing all the impurities together.

*Moisture:* (same as last year) Mash (do not crush or grind, simply flatten) a little more than 5 grams of seed in an iron mortar. Weigh out exactly 5 grams of the mashed seed into an official moisture dish and dry at 102 degrees C. for 5 hours. With official or referee samples make duplicate determinations and report as moisture content the average of at least two fairly concordant results.

*Oil and Ammonia* (Malowan-Picard Method):

**Method A:** Take a funnel of about 3½ inches diameter and cut off the stem to a length of 1½ inches. Close the stem by fusing together or by any other means. The stem shall hold one to two cc. of acid and the funnel 50 grams seed.

For the preparation of the seed, fill the stem with 1 to 2 cc. of concentrated HCl. Put into the funnel about 50 grams of seed and place the funnel into an asbestos oven at 130 to 140 C. for about half an hour, depending on the moisture content of the seed. It is advantageous to stir the seed after 10 minutes, so that the seed on top receive a better acid treatment. When the seed are dry remove and empty the funnel. Spread out the seed to permit the seed to cool and the last traces of acid to escape. Discard all seed which have become dark during treatment, usually only the two or three seed in the neck of the funnel, and grind in a mortar or mill to a degree of fineness which permits thorough mixing. The fineness of the ground seed will depend largely on the amount of moisture remaining in the seed. It is impossible to pass the ground seed through the mill a second time without gumming up the plates. After grinding the mill has to be cleaned and any larger pieces of seed remaining in the mill are ground in a mortar and added to the other portion.

**Or:** Instead of the funnel, take a 250 cc. beaker. Add 1 to 1½ cc. of concentrated HCl and place a perforated filterplate 2¼ inches at the bottom, fill loosely with about 50 grams of seed and dry in an oven 120 C. for about half an hour. Empty, discard any dark colored seed and any seed sticking to the beaker and proceed as described above.

*Oil:* Take 5 grams of the ground seed and extract for two hours like c. s. meal, then re-grind the extract two additional hours.

*Ammonia:* Use the same method as for meal. (The addition of paraffin or amyl alcohol is not necessary, because there is no danger of excessive foaming).

Make a moisture determination of the ground seed like of meal to be used for figuring the results back to the original seed.

Calculate results by the formula:

100-(% H2O in original seed—% H2O in ground seed) equals X.

X times the oil and NH3 values obtained gives the true values in the original seed.

A table has been figured out which will give the correction directly.

**Method B:**

*Oil*: Weigh 10 grams of seed, discarding any palpably defective seed or empty hulls, but make no selection otherwise. Place not more than 7 drops of Conc. HCl at the bottom of a 100 cc. beaker, then add the seed and place into an oven or on a hot plate till the acid has evaporated and the seed are dry. Spread the seed on a piece of paper to cool. Then grind the seed in an iron mortar until they are approximately as fine as meal. Wrap the ground seed just like meal and extract for three hours, regrind and extract for two hours longer.

*Ammonia*: Use double factor weight. To prevent foaming during distillation use a piece of paraffin the size of a pea or a few drops of amyl alcohol.

*Committee:* JOHN MALOWAN, Chairman; D. C. PICARD.

TABLE OF CORRECTION FOR OIL AND AMMONIA. FOR ANALYSIS OF COTTON SEED.

| Ammonia in Treated Seed, Per Cent | Difference in Moisture Content of Original and Treated Seed in Tens of One Per Cent | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
| | Corrections in hundred of one per cent | | | | | | | | | | | | | | | | | | | | |
| 3.50 | 00 | 01 | 01 | 02 | 03 | 04 | 04 | 05 | 06 | 06 | 07 | 08 | 08 | 09 | 10 | 11 | 11 | 12 | 13 | 13 | 14 |
| 3.75 | 00 | 01 | 02 | 02 | 03 | 04 | 05 | 05 | 06 | 07 | 08 | 08 | 09 | 10 | 11 | 11 | 12 | 13 | 14 | 14 | 15 |
| 4.00 | 00 | 01 | 02 | 02 | 03 | 04 | 05 | 06 | 06 | 07 | 08 | 09 | 10 | 10 | 11 | 12 | 13 | 14 | 14 | 15 | 16 |
| 4.25 | 00 | 01 | 02 | 03 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 09 | 10 | 11 | 12 | 13 | 14 | 14 | 15 | 16 | 17 |
| 4.50 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 09 | 10 | 11 | 12 | 13 | 14 | 14 | 15 | 16 | 17 | 18 |
| 4.75 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 5.00 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |

| Oil in Treated Seed, Per Cent | Difference in Moisture Content of Original and Treated Seed in Tens of One Per Cent | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
| | Corrections in hundreds of one per cent | | | | | | | | | | | | | | | | | | | | |
| 17.00 | 00 | 03 | 07 | 10 | 14 | 17 | 20 | 24 | 27 | 31 | 34 | 37 | 41 | 44 | 48 | 51 | 54 | 58 | 61 | 65 | 68 |
| 17.50 | 00 | 04 | 07 | 11 | 14 | 18 | 21 | 25 | 28 | 32 | 35 | 39 | 42 | 46 | 49 | 53 | 56 | 60 | 63 | 67 | 70 |
| 18.00 | 00 | 04 | 07 | 11 | 14 | 18 | 22 | 25 | 29 | 32 | 36 | 40 | 43 | 47 | 50 | 54 | 58 | 61 | 65 | 68 | 72 |
| 18.50 | 00 | 04 | 07 | 11 | 15 | 19 | 23 | 26 | 30 | 33 | 37 | 41 | 44 | 48 | 52 | 56 | 59 | 63 | 67 | 70 | 74 |
| 19.00 | 00 | 04 | 07 | 11 | 15 | 19 | 23 | 26 | 30 | 34 | 38 | 42 | 46 | 49 | 53 | 57 | 61 | 65 | 68 | 72 | 76 |
| 19.50 | 00 | 04 | 08 | 12 | 16 | 20 | 23 | 27 | 31 | 35 | 39 | 43 | 47 | 51 | 55 | 59 | 62 | 66 | 70 | 74 | 78 |
| 20.00 | 00 | 04 | 08 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 | 68 | 72 | 76 | 80 |
| 20.50 | 00 | 04 | 08 | 12 | 16 | 21 | 25 | 29 | 33 | 37 | 41 | 45 | 49 | 53 | 57 | 62 | 66 | 70 | 74 | 78 | 82 |
| 21.00 | 00 | 04 | 08 | 13 | 17 | 21 | 25 | 29 | 34 | 38 | 42 | 46 | 50 | 55 | 59 | 63 | 67 | 71 | 76 | 80 | 84 |
| 21.50 | 00 | 04 | 09 | 13 | 17 | 22 | 26 | 30 | 35 | 39 | 43 | 47 | 52 | 56 | 60 | 65 | 69 | 73 | 77 | 82 | 86 |

If treated seed are lower in moisture content than the original seed subtract correction, if the moisture content is higher add correction.

## ELECTED TO HONORARY MEMBERSHIP

The American Oil Chemists' Society, at its annual convention in New Orleans, unanimously elected to honorary membership Dr. C. A. Browne, Chief of the Bureau of Chemistry, U. S. Department of Agriculture.

# STATISTICS OF FATS AND OILS

The Department of Commerce announces that the factory production of fats and oils (exclusive of refined oils and derivatives) during the three-month period ended September 30, 1925, was as follows: Vegetable oils, 417,714,890 pounds; fish oils, 44,228,933 pounds; animal fats, 405,503,478 pounds; and grease, 82,086,827 pounds, a total of 949,534,138 pounds. Of the several kinds of fats and oils covered by this inquiry, the greatest production (304,332,491 pounds), appears for lard. Next in order is cottonseed oil with 187,023,490 pounds; linseed oil with 146,306,306 pounds; tallow with 98,939,400 pounds; coconut oil with 46,135,065 pounds; and corn oil with 24,452,073 pounds.

The production of refined oils during the period was as follows: Cottonseed, 141,975,654 pounds; coconut, 53,160,981 pounds; peanut, 1,324,416 pounds; and corn, 19,640,729 pounds. The quantity of crude oil used in the production of each of these refined oils is included in the figures of crude consumed.

The data for the factory production, factory consumption, imports, exports and factory and warehouse stocks of fats and oils and for the raw materials used in the production of vegetable oils for the three-month period appear in the following statements:

Production, Consumption, and Stocks of Fats and Oils

(In some cases, where products were made by a continuous process, the intermediate products were not reported.)

| Kind | Factory operations for for the quarter ending Sept. 30, 1925. | | Factory and Warehouse stocks |
|---|---|---|---|
| | Production (pounds) | Consumption (pounds) | Sept. 30, 1925. (pounds) |
| VEGETABLE OILS:[1] | | | |
| Cottonseed, refined | 141,975,654 | 290,715,002 | 57,110,066 |
| Cottonseed, crude | 187,023,490 | 153,168,850 | 55,972,288 |
| Peanut, virgin and crude | 1,974,068 | 1,545,465 | 845,038 |
| Peanut, refined | 1,324,416 | 3,180,548 | 737,949 |
| Coconut, or copra, crude | 46,135,065 | 101,160,945 | 36,338,337 |
| Coconut, or copra, refined | 53,160,981 | 52,304,881 | 15,885,028 |
| Corn, crude | 24,452,073 | 24,960,433 | 6,238,893 |
| Corn, refined | 19,640,729 | 3,859,277 | 7,393,938 |
| Soya-bean, crude | 301,318 | 3,148,909 | 2,737,931 |
| Soya-bean, refined | ..... | 1,415,704 | 1,055,338 |
| Olive, edible | ..... | 660,959 | 6,606,488 |
| Olive, inedible | ..... | 1,354,364 | 1,775,139 |
| Sulphur oil, or olive foots | ..... | 7,267,793 | 6,074,752 |
| Palm-kernel, crude | ..... | 12,544,652 | 2,648,860 |
| Palm-kernel, refined | ..... | 187,340 | 4,797 |
| Rapeseed | ..... | 2,952,018 | 2,198,889 |
| Linseed | 146,306,306 | 98,447,923 | 86,436,596 |
| Chinese wood or tung | ..... | 19,696,708 | 26,945,674 |
| Chinese vegetable tallow | ..... | 3,372,278 | 1,519,453 |
| Castor | 10,930,814 | 4,058,372 | 5,618,690 |
| Palm | ..... | 24,150,199 | 31,087,827 |
| All other | 591,756 | 3,083,777 | 2,610,618 |

| | | | |
|---|---|---|---|
| FISH OILS:[1] | | | |
| Cod and cod-liver | 252,142 | 3,027,352 | 4,383,906 |
| Menhaden | 22,775,798 | 9,185,509 | 22,279,477 |
| Whale | 6,013,718 | 13,093,208 | 28,046,463 |
| Herring, including sardine | 13,126,230 | 7,287,156 | 13,742,719 |
| Sperm | 566,625 | 234,598 | 2,312,898 |
| All other (including marine animal) | 1,494,420 | 1,928,497 | 2,808,346 |
| ANIMAL FATS: | | | |
| Lard, neutral | 9,843,653 | 5,765,459 | 4,107,387 |
| Lard, other edible | 294,488,838 | 2,875,561 | 50,356,751 |
| Tallow, edible | 10,866,034 | 10,049,700 | 2,394,379 |
| Tallow, inedible | 88,073,366 | 121,241,692 | 43,333,081 |
| Neat's-foot oil | 2,231,587 | 1,335,953 | 1,613,218 |
| GREASES: | | | |
| White | 13,543,967 | 6,164,048 | 5,295,228 |
| Yellow | 13,621,218 | 23,087,189 | 9,527,593 |
| Brown | 10,469,944 | 7,278,092 | 7,143,166 |
| Bone | 6,496,747 | 171,400 | 1,453,705 |
| Tankage | 12,804,781 | 628,673 | 4,020,500 |
| Garbage or house | 19,296,187 | 22,320,521 | 9,811,959 |
| Wool | 926,447 | 981,599 | 1,849,144 |
| Recovered | 3,286,071 | 2,016,320 | 1,388,986 |
| All other | 1,641,475 | 1,906,870 | 1,962,102 |
| OTHER PRODUCTS: | | | |
| Lard c'pounds & other lard substitutes | 300,877,629 | 185,847 | 16,032,579 |
| Hydrogenated oils | 103,625,819 | 98,471,208 | 8,220,311 |
| Stearin, vegetable | 3,776,951 | 5,089,122 | 951,322 |
| Stearin, animal, edible | 16,692,382 | 16,084,260 | 3,096,946 |
| Stearin, animal, inedible | 6,338,816 | 6,238,595 | 3,079,746 |
| Oleo oil | 29,763,438 | 11,164,384 | 10,775,098 |
| Lard oil | 8,505,355 | 5,397,282 | 4,790,819 |
| Tallow oil | 3,418,018 | 2,841,277 | 1,858,090 |
| Fatty acids | 29,867,967 | 32,436,354 | 3,998,904 |
| Fatty acids, distilled | 13,491,811 | 15,514,830 | 2,314,482 |
| Red oil | 12,208,213 | 6,342,697 | 7,449,844 |
| Stearic acid | 6,321,969 | 2,207,728 | 1,939,400 |
| Clycerin, crude 80% basis | 24,591,340 | 28,862,046 | 7,444,186 |
| Glycerin, dynamite | 9,491,620 | 9,457,015 | 6,843,724 |
| Glycerin, chemically pure | 13,975,075 | 1,330,346 | 5,741,800 |
| Cottonseed foots, 50% basis | 20,767,725 | 18,790,786 | 6,773,679 |
| Cottonseed foots, distilled | 19,626,663 | 25,723,597 | 6,843,600 |
| Other vegetable oil foots | 9,836,025 | 9,240,004 | 1,023,329 |
| Other vegetable oil foots, distilled | 392,865 | 32,242 | 201,631 |
| Acidulated soap stock | 7,752,189 | 10,586,668 | 5,864,428 |
| Miscellaneous soap stock | 825,184 | 1,292,005 | 225,625 |

[1]The data of oils produced, consumed and on hand by fish oil producers and fish canners were collected by the Bureau of Fisheries.

Raw Materials Used in the Manufacture of Vegetable Oils

| | Tons of 2000 pounds | | | Tons of 2000 pounds | |
|---|---|---|---|---|---|
| | Consumed July 1 | On hand | | Consumed July 1 | On hand |
| Kind | to Sept. 30 | Sept. 30 | Kind | to Sept. 30 | Sept. 30 |
| Cottonseed | 624,070 | 776,017 | Flaxseed | 219,006 | 79,361 |
| Peanuts, hulled | 2,878 | 1,135 | Castor beans | 12,413 | 5,248 |
| Peanuts in the hull | 35,584 | 9,473 | Mustard seed | 652 | 878 |
| Copra | 231 | 244 | Soya-beans | 1,126 | 53 |
| Coconuts and skins | 700 | 74 | Olives | ... | ... |
| Corn germs | 42,832 | 415 | Other kinds | 1,519 | 197 |

Imports of Foreign Fats and Oils, Quarter Ended September 30, 1925

| Kind | Pounds | Kind | Pounds |
|---|---|---|---|
| Whale oil | 2,691,068 | Palm oil | 36,569,573 |
| Cod and cod-liver oil | 5,037,165 | Palm-kernel oil | 2,585,022 |
| Other fish oils | 1,127,662 | Peanut oil | 504,613 |
| Beef and hog fats | 302,314 | Rape oil | 3,692,445 |
| Wool grease | 1,809,782 | Linseed oil | 436,765 |
| Grease and oils, n.e.s. (value) | $21,937 | Soya-bean oil | 1,172,584 |
| Chinese wood oil or nut oil | 20,120,780 | Vegetable tallow | 543,411 |
| Coconut oil | 29,658,440 | Vegetable wax | 1,705,777 |
| Olive oil, edible | 22,510,563 | Other vegetable oils | 1,329,852 |
| Sulphur oil, or olive foots | 8,888,422 | Glycerin | 3,593,747 |
| Olive oil, denatured | 1,605,608 | | |

Exports of Foreign Fats and Oils, Quarter Ended September 30, 1925

| Kind | Pounds | Kind | Pounds |
|---|---|---|---|
| Fish oils | 11,288 | Palm and palm-kernel oil | 463,520 |
| Other animal oils, fats and greases | 51,954 | Peanut oil | 170,356 |
| Chinese nut oil | 608,838 | Soya-bean oil | 909,520 |
| Coconut oil | 186,816 | Other vegetable oils, fats, and greases | 397,077 |
| Olive oil, edible | 18,762 | | |

Exports of Domestic Fats and Oils, Quarter Ended September 30, 1925

| Kind | Pounds | Kind | Pounds |
|---|---|---|---|
| Oleo oil | 20,948,240 | Oleomargarin containing animal fats | 133,155 |
| Neat's-foot oil | 312,797 | Other animal greases, oil and fats | 18,043,601 |
| Other animal oils | 584,697 | Coconut oil | 4,563,252 |
| Fish oils | 138,568 | Cottonseed oil, crude | 1,250,727 |
| Oleo stock | 2,967,670 | Cottonseed oil, refined | 7,071,799 |
| Tallow | 4,120,106 | Linseed oil | 686,289 |
| Lard | 155,799,386 | Soya-bean oil | 363,182 |
| Lard, neutral | 5,837,728 | Corn oil | 925,394 |
| Lard compound containing animal fats | 4,440,530 | Vegetable olemargarin | 19,740 |
| Oleo and lard stearin | 2,040,656 | Vegetable oil lard compound | 2,094,900 |
| Grease stearin | 874,375 | Vegetable soap stock | 2,502,623 |
| Oleic acid, or red oil | 98,172 | Other vegetable oils and fats | 2,137,618 |
| Stearic acid | 288,060 | Glycerin | 414,422 |

# ABSTRACTS FROM OTHER JOURNALS

**Determination of Melting Point of Cacao Butter.** H. Fincke. Z. angew. Chem. **38,** 572. (1925)—Old samples of Cacao Butter should not be re-melted; the capillary tube should be filled by pressing it into the fat. With fresh liquid samples, stirring should be resorted to during solidification, the melting-point determined as above after an interval of at least one month, and again every few days until constant. For a considerable number of samples of pure cacao butter, the limiting values found were 32°-34°, most of the values lying between 32.5° and 33.5°. (Through J. S. C. I. **44,** No. 34.)—G. L. R.

**Fat of Goat's Butter.** H. D. Richmond, Analyst, **50,** 62-64 (1925).—The author points out that Knowles and Urquhart (Analyst, 1924, 49, 509) in suggesting that Goat's Butter might be condemned as cow's butter adulterated with cocoanut oil, have calculated their mean Polenske figures from Richmond's formula in an incorrect manner. The corrected results show in nearly every case such high Riechert-Wollny figures that no supposition of the sample consisting of cow's butter and coconut oil could be entertained. (Through J. S. C. I. **44,** No. 14.)—D. G. H.

**Catalytic actions at solid surfaces.** XIII. Factors controlling selective hydrogenation, with particular reference to certain terpene derivatives. E. F. Armstrong and T. P. Hilditch Proc. Roy. Soc. A 108-121-131. 1925.)—The normal course of affairs is the complete hydrogenation of any unsaturated system which has become associated with an active atom of catalyst, and thus when selective hydrogenation of a diethylene compound occurs only one of the unsaturated centres is associated with the metallic catalyst at the moment of catalytic change. In binary mixtures of substances, each containing an ethylene linkage, the less highly substituted is hydrogenated in preference to the other. By application of the latter generalisation to previous investigations of certain turpene compounds (J., 1922, 32A), the positions of the ethylene linkages in certain of these substances have been fixed. (Cf. A., June.) (Through J. S. C. I. **44,** No. 26).—J. S. C.

**Environmental factors affecting the protein and the oil content of soya beans and the iodine value of soya bean oil. J.** Amer. Soc. Agron. 16, 636, 645. (1924.)—Applications of lime, organic matter, and rock phosphate increased the percentage of protein and decreased the oil content of soya beans. Potassium applied in addition to phosphorus, lime and residues decreased the protein content and increased that of oil. Production of oil was increased by application of organic matter and limestone, whilst phosphorus and potassium had little effect. The iodine value of the oil varied in the different varieties of soya beans; no consistent relation was found to exist between the iodine value and location or soil treatment. (Through J. S. C. I. **44,** No. 14.)—A. A. E.

**Polymerisation of fatty oils.** J. Marcusson Z. agnew. Chem. 1925, **38,** 148-149; cf. J., 1922, 867 A.—Salway's theory (J., 1920, 324 r) is criticized, Ubbelohde's results ("Analyze und Technologie der Oele und Fette," 1920, II., 357), and the following facts being shown not to agree with it. When tung oil is heated in an atmosphere of carbon dioxide at 280 per cent and the unchanged oil afterwards removed by washing with acetone, benzene, and alcohol, a gelatinous mass remains. This is hydrolysed by hot alcoholic potassium hydroxide; the mixture of acids so obtained has a molecular weight (calculated from cryoscopic measurements, in camphor or glacial acetic acid solution) of about 500. Polymerised linseed oil, isolated in a similar way, is a viscous mass, yielding fatty acids the mean molecular weight of which is again about 500. "True polymerisation" therefore has taken place. These polymerised oils contain no mono- or diglycerides. (Through J. S. C. I. **44,** No. 15.)—W. A. S.

**Behavior of alcohol towards acid olive oil.** S. Fachini and S. Somazzi. Atti Congr. Naz. Chim. Ind. (1924, 397-399)—Olive Oil can be obtained quite free from acid by repeated washing with 94% alcohol, but a considerable amount of the oil itself also passes into solution. Experiments on mixtures of pure neutral olive oil and of the fatty acids separated therefrom show that the solubility of the oil in alcohol increases with rise in temperature and with the concentration of the fatty acids present. By using comparatively large proportions

of alcohol it is, however, possible to render neutral an olive oil with an acidity as high as 20%, and thus utilise oils which at present are not refined but are used for soap making, etc. (Through J. S. C. I. **44**, No. 15.)—T. H. P.

**Manner in which oil and oleic acid behave with water.** J. F. Carriere. Rec. trav. chim. (1925, **44**, 121-129).—Whereas the interfacial equilibria of neutral oil-water, or of oleic acid-water, are instantly established, oil containing traces of oleic acid behaves differently from pure oil, owing to passage of acid into the interfacial layer. The anomalous behavior of oil and water which certain observers have attributed to hydrolysis of the oil, is explained as due to the presence of impurities. Because of the use of impure material, the interfacial tensions of neutral oil-water and of oleic acid-water respectively, as given in the literature, require correction to about 26 and 10.5 dynes/cm, respectively at 20°. Whereas neutral oil is not affected by ammonia vapor after establishment of equilibrium on the surface of water, oil containing 0.1% of oleic acid becomes violently disturbed, and this serves for the detection of traces of fatty acids, as distinct from other impurities.—(Through J. S. C. I. **44**, 15.)—F. M.H.

**Physical and chemical properties of biosterin (vitamin A) and its physiological significance.** K. Takahashi, Z. Nakamiya, K. Kawakami and T. Kitasato (Sci. Papers Inst. Phys. Chem. Res., 1925, **3**, 81-146).—Biosterin was separated from Cod Liver Oil in the manner previously described (J., 1923, 904A), and further purified by extraction of the petroleum ether solution with methyl alcohol, by crystallization from acetone at —65°, and by fractional distillation in vacuo. The final purified product maintains health in rats for several weeks when administered in daily doses of 0.001 mg. as a sole source of vitamin A. In doses greater than 10 mg. daily it is toxic. Biosterin, $C_{27}H_{42}(OH)_2$, is a reddish yellow viscous oil, $d^{15}$ 0.9561; $n^{20}$ 1.52517; optically inactive; b.p. 147°/0.2 mm.; mol. wt. 375 approx.; iodine value (Wijs) 178; acetyl value 137. (Cf. A., Nov.). (Through J. S. C. I. **44**, 44.)—P. E.


## *USE*

**86-88 High Test Gas Machine Gasoline**
**Known as *GAS-O-LITE***

For gas machines. Guaranteed to produce more gas per gallon than any other gasoline on the market. Free evaporating. No residue. Exclusive manufacturers, not jobbers.

*Send us a trial order.*

**THE HICKOK PRODUCING COMPANY**
**Toledo, Ohio**

**PURE NICKEL**

Dime Brand

"twice as good as theirs."

Rod—Wire—Sheet—Tape

Seamless Drawn Tubing for the Chemical Field

H. BOKER & CO., Inc.
102 Duane St., NEW YORK CITY

Boston Cleveland Chicago Montreal

**THE BATTLE LABORATORY**

H. B. Battle, Ph.D., Prest.

Analytical and Consulting Chemists

MONTGOMERY, ALA.

**HOUSTON LABORATORIES**

P. S. TILSON, M.S.
Analytical and Consulting Chemist

215½ Main St. HOUSTON, TEXAS

**CURTIS & TOMPKINS**

Analytical, Industrial and Engineering

CHEMISTS

331 California St. SAN FRANCISCO

**LAW & COMPANY, Inc.**

Consulting and Analytical

CHEMISTS

Atlanta, Ga. Wilmington, N. C.

**Barrow-Agee Laboratories**
ANALYTICAL AND CONSULTING CHEMISTS

*Main Office and Laboratory*

Memphis :: Tennessee

*Branch Laboratories*

Shreveport, La. Greenville, Miss.
Jackson, Miss. Little Rock, Ark.

F. B. PORTER, B.S., Ch.E., President
R. H. FASH, B.S., Vice-President

**THE FORT WORTH LABORATORIES**

Consulting, Analytical Chemists and Chemical Engineers

328½ Monroe Street

P. O. Box 1008 Fort Worth, Texas

**Chas. W. Rice & Co.**
ANALYTICAL AND CONSULTING CHEMISTS

P. O. Drawer 538

Columbia :: South Carolina

**Chattanooga Consulting Laboratories**

Manufacturing,
Analytical and Consulting Chemists

808½ Pine Sts., Chattanooga, Tenn.

Dr. S. B. Higgins, Manager

**AMERICAN JOURNAL OF BOTANY**

**Devoted to All Branches of Botanical Science**

Established 1914. Monthly except August and September. Official Publication of the Botanical Society of America.

Subscription $6 a year. Volumes 1–11 complete, $79 post free. Single numbers, 75 cents, post free; Prices of odd volumes on request. Foreign postage 40 cents.

**Address**

**American Journal of Botany,**
**Brooklyn Botanic Garden,**
**Brooklyn, N. Y.**